A STUDY OF THE FACTORS INFLUENCING THE PRODUCTION AND COST OF PRODUCTION OF MILK IN THE EDMONTON AND CALGARY AREAS

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Preface

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SCOPE AND PURPOSE OF THE STUDY

During the past few years producers and distributors, both in Edmonton and Calgary have encountered many problems with respect to the milk industry. The producers, especially those shipping milk to the distributing plants, claim that the existing prices received from their milk are not sufficient to cover the costs incurred in producing the milk. The city sweet price, i.e., the price received from that portion of the milk being sold as whole milk, may be sufficient to cover costs of production, but a large portion of each producer's total production of milk is sold as surplus milk at a much lower price, which brings down the aggregate price received from milk to such a low figure that many dairymen claim that the income received from milk is less than the cost of producing the milk. Some producers are of the opinion that the distributors realize too large a profit on this surplus milk.

The distributing plants claim they are not receiving excessive profits, and they also maintain they are not receiving a steady supply of sufficiently high quality milk which can be used for their city sweet trade.

A discussion of the whole problem is far beyond the scope of this thesis, and in order that some significant facts may be shown, the study

will be limited to "The Factors Influencing the Production and Cost of Production of Milk in the Edmonton and Calgary Areas".

To find the cost of producing 100 lbs. of milk is not the sole aim of this study. The cost in itself is of little value. The purpose is to analyse the various factors making up the cost and to show how they effect the production and the cost and hence the returns received from milk. The farmer is not interested in the physical output except in the sense that it influences his income. The problem then is to find the combination of factors giving the highest production with the greatest net return. To attain this and the cost and amounts of the separate factors making up the total cost of producing 100 lbs. F.C.M.[1] have been calculated.

Since the west has become more densely populated, new land is not as plentiful as it formerly was, and the prices of good land have increased. Consequently the farmer must get larger returns per acre if he wishes to receive the same profit as previously. More attention must be given to efficient methods of production in order that the cost of production may be reduced. Probably the first step in lowering the cost is to find out as accurately as possible what the various costs are, and then by comparison with costs of similar studies, methods may be devised whereby those costs that are too high can be lowered.

Many of the costs involved in the production of a commodity, especially in agriculture, are joint costs, and can not be allocated directly to the production of one specific commodity. Nevertheless, where the same technique is used in calculating the various milk production costs between the different producers, it is possible to use the figures obtained as a means of comparison of the effeciency of the different dairymen. As John A. Hopkins

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[1] F.C.M. - fat corrected milk. See Page 12.

and Paul Tegler (46) state: "When figures are constructed with care they are usable as indicators of efficiency in particular enterprises as between farms, but such use should be limited to groups of farms operating under essentially similar conditions and in the same year", and later they go on to say that: "One of the least questioned uses of costs per unit of produce seems to be for the purpose of comparing effeciency in the production between different farms". There seems to be little contention of this point, but criticism does arise when an attempt is made to determine what the price should be from these arbitrary cost of production figures. Therefore, the primary purpose of this study will be to show and explain the differences in efficiency and costs of production of milk between the different farms within the Calgary and Edmonton districts, during a similar period of time.

DESCRIPTION AND COMPARISON OF THE AREAS STUDIED

Before entering into a discussion of the main body of the thesis, it is necessary to note some of the differences that exist between these two areas - Calgary and Edmonton, and point out the influences that the environmental factors present in these areas may have on later discussion.

The population of the two areas of Calgary and Edmonton is similar, 83,761 and 79,197 (1931 Census) respectively. The total milk consumption is around 25,000,000 lbs. a year in both cities, and at the present time both produce a substantial surplus, approximately 40%. During the past year, however, Calgary has had shortages, and there have been periods since the War when the Calgary distributors have had to go far afield to secure a sufficient volume of milk to meet the demand. During the past years the pro-

duction in Calgary has varied considerably more than in Edmonton. A drop from 449 licensed dairymen in Calgary in 1928 to 395 in 1933 gives some indication of the cyclic nature of the business in that city. In Edmonton there has not been the wide fluctuation in the number of licensed dairymen. At the present time there is a total of 226 licensed dairymen in Edmonton, 220 producer shippers and 47 producer distributors.

Edmonton is in the parkland black soil belt, while Calgary belongs to the prairie dark brown soil area. Over a forty-nine year period the average rainfall in Edmonton was 17.27 inches, and in Calgary over a forty-eight year period the average was 16.60 inches. The seasonal distribution of rainfall, however, does vary considerably more than these figures indicate. These physical factors contribute to the more sporadic yields in the Calgary area, and are the main reasons for the instability of the farming in that area as compared to the Edmonton area. Also, Calgary is the centre of several speculative industries such as the oil business, tourist trade, and the prairie wheat trade, which contribute to the instability of that district.

The average size of farm for the Edmonton producer shipper is 278 acres, of which 177 acres are in crop land and only 53 acres in pasture. For the Calgary producer shipper, the average size of the farm is 371 acres, of which 199 acres are in crop land and 141 acres in pasture.

Farm indebtedness was higher in the Edmonton area than in the Calgary area, but at the same time the capitalization and also the net equity were higher in the former area, (Table 1).

TABLE 1 - INVENTORY VALUATION, INDEBTEDNESS AND EQUITY ON 41 EDMONTON AND 27 CALGARY DAIRY FARMS

	Value per Acre	Inventory Valuation	Indebtedness	Equity
	$	$	$	%
Edmonton	58	19,403	4,213	76
Calgary	33	11,000	1,328	71

Since there was more certainty and stability in the Edmonton farming district as compared to the Calgary district, there was a greater tendency to build up the farms more in that area, and also to invest more money in machinery and livestock.

The breeds of dairy cattle and their proportions are similar in both areas, approximately 90% of the farm herds being predominately Holstein and 10% Shorthorns, Jerseys, and of mixed breeding. Less than 20% of the herds were partially or completely made up of pure breeds. The average production per cow was higher in Edmonton (7895 lbs.) than in Calgary (6559 lbs.). The average test was slightly higher in the Calgary district (3.65) as compared to (3.57) the Edmonton area.

REVIEW OF LITERATURE

In this section on the review of literature, only those results will be given that pertain to this analysis. In many of the studies reviewed it was difficult to ascertain whether any conclusions had been reached. However only those results will be given that appear to be quite definitely stated.

1. Production per Cow:- It was quite universally concluded that the dominant factor affecting the total cost of producing milk was the yield per cow. This factor was brought out in many of the studies (16), (2), (5), (8), (9).

2. Factors Affecting Production per Cow and the Cost:- There was not the universal agreement here as in the case of production per cow. Most workers, however, agreed that feed and the inherent capacity of the cows were the most important factors affecting the yield per cow and the cost of producing milk.

(a) Feed:- Ezekiel McNall and Morrison (8) concluded that the nutritive ratio and T.D.N. were the two main factors of the feed that influenced the yield per cow and the cost of producing milk. Pond and Ezekiel (11) came to similar conclusions. Catherwood (12) pointed out that the increase in production for increase in grain was not in a direct ratio, and that heavier feeding may not always be profitable. Most of the investigators (33) (16) (26) (43) state that feeding large quantities of concentrates to the cows was generally not profitable unless the cows had the inherent ability to utilize the concentrates fed. Hampson (34) points out that the relative prices of feed and milk influence the kind of feeds fed.

(b) Inherent Capacity of the Cow:- Several of the studies (5), (11), (12), (16), (43), list the inherent capacity of the cows to produce milk as the dominant factor affecting the milk production and the cost of producing milk. Ross, Hall and Rhode (5) state that "If production is increased by increasing the potential ability of the herd, the amount of nutrients consumed per unit of produce decreases at an ever increasing rate". There were, however, different viewpoints. Some of the workers accepted the cows as they were found on the farm and indicated methods of increasing the yield of these cows, while others pointed out methods of increasing the production by securing better cows with greater inherent ability.

(c) Fat Test:- The fat test was considered by some of the investigators (8),

(11) as having a direct relation to the production of milk and income from milk. Pond and Ezekiel (11) found that fat test accounted for 40.1% in the variation in the yield of milk. Ezekiel, McNall and Morrison (8) attributed only 18.6% of the variation in the yield of milk to differences in the fat test. Gaines and Davidson (40) came to the conclusion that the yield of milk is inversely proportional to the energy value of the milk solids per unit of milk, and they derived the formula F.C.M.[1] equals .4 M plus 15 F to bring all milk to a 4% fat level. In a later bulletin (39) Gaines substantiates the conclusions arrived at in (40).

(d) Season of Freshening:- After feed, inherent capacity of cows, and fat test, the season of freshening appeared to have the greatest affect on the yield per cow. In many of the studies (8), (9), (11), (12), (16), (27), the investigators point out the influence of this factor, and the general conclusion was that fall freshening gave a larger production than freshening at any other season of the year. Selby, Burrier and Brandt (16) concluded that "Fall freshening tends to prolong the milking period and increase the total production since the cows 'freshened' twice during the year, once when they calve in the fall and again when pasture comes in the spring".

3. Labor:- Labor was found to be the largest individual cost item except feed, and consequently was concluded to have a significance bearing on the cost of producing milk (14), (15), (16), (17), (9), (44). Generally, however, no mention was made of any close relationship between the hours of labor used and the yield per cow, although a few (44), (8), state that the higher producing cows require less labor per 100 lbs. milk than the lower producing cows. Others (14, (15), (17), came to the conclusion that size of herd and efficiency of the labor had the greatest affect on the amount

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[1] F.C.M. - See Page 12.

of labor used. Selby, Burrier and Brandt (16) go further by stating that the efficiency depends upon size of farm, equipment available, and arrangement of farm buildings. Stephens, (17), claimed the optimum size of the herd depended upon the size of the farm.

4. Minor Cost Items:- The remaining cost items such as annual cow cost, building charge, bull charge and the innumerable miscellaneous items of cost, were treated differently by the different investigators. They were generally considered as having only a minor affect upon the total cost of producing milk. Adams (4) classified them as indirect charges, while feed and labor made up the direct charges.

5. Management:- Many of the studies (4), (8), (9), (11), pointed out that management was an important factor affecting the economical production of milk. However, very few attempted to classify the farms according to the managerial ability of the dairyman. Pond and Ezekiel (11) classified the manager as good, fair, poor and unsatisfactory, and concluded that management was the most important factor affecting the production of milk. Under management they include all of the previous factors mentioned, and state that a good manager was that dairyman who used the combination of factors that gave the largest production of milk for the least cost. Ezekiel, McNall and Morrison (8) state in the following way: "The economical production of milk depends upon the proper combinations of all of the elements concerned in the dairy enterprise with regard to basic physical relations and existing costs and prices".

The following table was compiled by Selby, Burrier and Brandt (16) (Table 61) and represents the result of seventy-three published reports throughout the United States on the cost of producing milk.

TABLE 2 - SUMMARY OF PRODUCTION AND QUANTITY COST DATA BY REGIONS OF THE UNITED STATES

	Eastern United States	Central United States	Western United States	All Reports
Number of Reports	30	25	18	73
Number of Farm Records	3,050	1,021	573	4,644
Number of Cow-Years	58,101	16,936	19,429	94,466
Cows per farm	20	19	41	25
Milk per cow Annually, pounds	5,737	5,949	6,307	5,950
Butter fat test (62 reports), per cent	3.6	3.8	4.1	3.8
Amount per cow annually				
Roughage, pounds	4,169	3,402	4,945	4,098
Succulents, pounds	5,684	6,657	4,641	5,760
Concentrates, pounds	1,733	1,753	1,026	1,566
Pasture (49 reports), days	145	164	151	153
Labor, hours	155	165	139	155

Methods of Analysis as Used by Other Investigators

Three methods have been used to analyse the dairy farm business and determine the cost of producing milk as pointed out by Severence and Hare (3).

1. The Farm Basis:- According to this method every expense incurred in operating the entire farm business is assumed to be an expense of operating the dairy, and all receipts other than milk and its products including crops, etc., are subtracted from the gross cost of operating the farm, and what is left is the net cost of producing milk. This method is satisfactory where the farms are highly specialized and dairying is the major enterprise. It is useful in that it shows the farm as a unit, and does not necessitate splitting of the various costs, such as interest, depreciation, etc., but it is not practicable for an analysis where individual costs are wanted to

show their separate affects on the whole cost of producing milk. Under this method non-dairy enterprises, if they prove to be profitable, will decrease the cost of producing 100 lbs. of milk, whereas if they prove unprofitable they will increase the cost of producing 100 lbs. of milk.

2. Herd basis:- On this basis the herd is assumed to be the unit, and all the expenses contracted in maintaining dairy stock of all ages are treated as an expense of the production of milk. All receipts other than from the sale of milk and its products including receipts from the sale of young stock, are subtracted from the gross cost of operating the herd to determine the net cost of producing milk. Other enterprises such as production of crops, etc. are treated as an independent farm business, and all the feed fed is charged at its market value. This method is satisfactory where the herd is used primarily for the production of milk, but it is obvious that analysing expensive purebred herds and the lower valued grade herds by this method would lead to such a variability that the two herds would not be on a comparable basis, since the sale of the livestock would materially affect the cost of producing the milk. Hence this method of analysis is not always satisfactory.

3. Cow Basis:- Under this method the dairy herd consisting of all mature cows and the herd sire, are considered the unit, and all the costs incurred by them are considered as the costs of the production of milk. Every product of the farm used by the producing herd is charged to milk production at its market value at the farm, regardless of what it may have cost to produce. Since the maintainance of the dam and sire is charged to milk production, the value of the calves at birth is credited to milk production, but the raising of these calves is considered as a separate unit. This method of

analysis of the cost of producing milk was regarded as the most applicable for this study. It permits the producer to compare his cost with that of other producers, and thus enables him to lower those costs which are high by following methods similar to those used by other producers whose costs are lower.

This method of procedure which is often called the "cost accounting method" is important for the following reasons:

(1) It shows the individual producer whether his dairy is profitable and enables him, by careful analysis, to detect which operations of the dairy are unprofitable or which costs are too high.

(11) It enables the producer to increase his efficiency by comparison with other studies. At the same time the farmer is able to detect where his costs are high and can devise means of lowering them.

(111) The dairy producer may be getting a fair return from his farm and still be losing money from the production of milk. In such cases it would be to his advantage to dispose of his dairy herd and develop the more profitable enterprises of his farm. The cost accounting method does not show which farm enterprise is the most profitable, but it does show in so far as the various costs can be separated, the exact status of the dairy enterprise.

METHOD OF COLLECTING DATA AND METHOD OF ANALYSIS

The data was obtained by the survey method, each dairyman being personally interviewed by the field enumerator. There were sixty-eight records taken during the summer of 1934, forty-one in the Edmonton and twenty-seven in the Calgary milk sheds. The farms visited were picked at random, although an attempt was made to get as representative a sample as possible. The information was obtained by personal interviews with the dairymen, and lasted

from one to two hours, during which time the producer gave actual and estimated figures to the enumerator of the details of his business.

The primary purpose of the original survey was to determine the profitableness of dairying and the relation of the factors influencing the selection of the farm "setup" on the dairy farms in the immediate vicinity of Edmonton and Calgary. Since the records were not originally made for an analysis of the cost of producing milk, some difficulty was encountered in allocating the various costs directly to milk production. In some cases it was necessary to make certain calculations according to the results of other investigators who made surveys of a similar type and in similar areas.

METHOD OF ANALYSIS

The method of allocating the cost to the production of milk will be discussed under the following headings:- feed, labor, buildings, cow charge and miscellaneous charge.

The total production of milk was corrected to a 4% basis before it was used to calculate the average costs per 100 lbs. F.C.M. for the various items. The milk was brought to a 4% basis according to the following formula as worked out by Gaines and Davidson (40):- F.C.M. equals .4 M plus 15 F., where F.C.M. is fat corrected milk and M is actual yield of milk, and F is the actual yield of fat. This formula corrects the milk yield for the influence of the fat content and brings it to a physiological equivalent of 4% milk.

1. Feed

The dairymen gave an estimation of the amount and value of the feed fed to the dairy herd during the past year (1933-34). Where the feed was home grown it was valued at prevailing market prices.

The T.D.N. (total digestible Nutrients) contained in each feed was calculated according to Henry and Morrison Tables (43). The T.D.N. consumed by the dairy cow while on pasture were calculated according to the results of Hodgson, Grunder, Knott and Ellington (41). They used the term "cow day" and found that on the average a cow consumed 16 lbs. of T.D.N. per day while on pasture. In the records the farmer gave an estimation of the months his cows were on pasture during the year.

As a means of comparison with the actual T.D.N. the theoretical T.D.N. required by a herd to produce a given amount of milk was also calculated according to Henry and Morrison standards (43). They gave tables showing the number of pounds of T.D.N. required for maintainance of a one thousand pound cow, and the number of pounds of T.D.N. required to produce a pound of milk for different butter fat tests. As the weights of the cows were not known they were assumed (after examining records of weights of cows of different herds) to be 1250 lbs. for the average Holstein, and 950 lbs. for the average Jersey. Practically all the herds encountered could be classified under these two average weights.

Value of Pasture

In this study the farmer did not give the value per acre of his pasture land, but only the value per acre of his total farm including all improvements. It was concluded after comparing land values that the value per acre of the pasture was approximately one-half of the total land value per acre. Five per cent of this was taken as the annual cost per acre per cow. This was considered high enough in the localities under study to include the total pasture expense per cow per acre. Larson and Putney (44) worked out the pasture charge in a similar manner. After calculating the

pasture charge it was added on to the other feed costs to obtain the total feed cost.

From the calculations on feed the following figures were obtained:

(a) Cost of Feed per cow
(b) Cost of Feed per 100 lbs. F.C.M.
(c) Theoretical T.D.N. required per 100 lbs. F.C.M.
(d) Actual T.D.N. fed per 100 lbs. F.C.M.

Labor

In the records the farmers gave an estimation of the number of hours of labor spent in the dairy each day. They also gave the valuation and the number of months of hired and family labor used on the farm during the year (1933-34). From this information the number of hours used to produce 100 lbs. F.C.M. and also the value of labor per hour were calculated. The value per hour was based upon the assumption that the farmer worked on an average of twelve hours a day, which appeared to be the tendency for the dairymen in these two areas. It was also assumed that the cost of labor per hour on the whole farm and in the dairy were the same.

The theoretical amount of labor for 100 lbs. F.C.M. was calculated according to the results of Venstrom and Headley (15) who demonstrated that for every addition of one cow to the herd, the chore time was reduced by 1.6 hours per cow per year. They worked out the following table for the number of hours of labor required for the various sized herds:

10	cows	- 148	hours	per	cow	per	year
20	"	132	"	"	"	"	"
30	"	116	"	"	"	"	"
40	"	100	"	"	"	"	"

Using this as the theoretical amount of labor required for the various sizes of herds, the theoretical number of hours required to produce 100 lbs.

F.C.M. was calculated. Thus for labor, the following results were obtained.

(a) Cost of labor per cow

(b) Cost of labor per 100 lbs. F.C.M.

(c) Theoretical number of hours required to produce 100 lbs. F.C.M.

(d) Actual number of hours required to produce 100 lbs. F.C.M.

3. Building Charge

The building charge includes the interest, depreciation, taxes, insurance, and repairs which were chargeable against the dairy herd. Since feed was charged at the market value, storage buildings were not included in the cost of milk production. Interest was charged at 5% and depreciation at 4%. The taxes and insurance costs were obtained by calculating the proportion of the total insurance and taxes which were chargeable against the dairy herd. Other workers (6), (7), (14) used similar methods for finding the building charge.

4. Annual Cow Charge

The annual cow charge consists of taxes, insurance, interest and depreciation. In this study there were no taxes nor insurance on the cow. Hence these two items did not enter into the annual cow charge. Interest was computed at 5% on the estimated value of the cow. Since the records did not contain complete information on the depreciation of the herd, it was necessary to use an average figure obtained from the results of other investigators. After reviewing the literature on depreciation (15), (16), (44), (1), (3), (4), (6), (7), it appeared that 7½% was the average of the reports investigated, and was used to calculate the depreciation charge of the cows in this study. The interest was added to the depreciation to give the total cow charge for the cows in these areas.

5. Miscellaneous Charges

The miscellaneous cost includes the following items:- breeding fees, equipment charge, hauling milk, veterinary fees, feed grinding, milk license, gas and oil used for pumping water, and other incidental costs which are attributable to the production of milk. Where the producer was also a distributor the cost of bottles and caps was added to the miscellaneous costs.

In most of the other studies the bull charge was kept separate, but in this study the bull cost was so small that it was included under miscellaneous charge. The cost of feed and labor for the bull was included in the total feed and labor costs for the herd. Depreciation on the bull was charged at 2% of his given value. This is in accordance with Selby and Jones (37) work on the cost of keeping dairy bulls.

Ten per cent was charged for the depreciation and repairs on all equipment and 5% as interest on that portion of the equipment used by the dairy herd. For most of the producer distributors it was impossible to differentiate the cost of labor for hauling milk from the cost of farm labor, and hence it was not included in the labor charge or miscellaneous charge of these groups.

Credits

The cost figures represent the total costs without any credits being deducted for calves or manure. The calves at birth were valued very low, and often they were given no valuation except in the pure bred herds. Also, the value of manure was not ascertained; however many farmers regard the cost of hauling it away equal to the value. Hence these two items

would have little if any effect on the costs of milk production in these two areas.

RELATIONSHIP OF THE PRODUCTION PER COW TO THE COST OF PRODUCING MILK

In this section only the total costs will be considered. The individual items will be left for later discussion. The cost of production figures will first be presented and analysed, showing variability and relationships between different groups. Finally an analysis will be made of the relationship between the total cost and the yield per cow.

There are two groups, P.S. and P.D. (producer shippers and producer distributors) in both the Edmonton and the Calgary areas. Each of these groups are divided into classes according to the average production per cow. These classes are arranged in order of increasing production per cow. The annual cow costs per cow and per 100 lbs. F.C.M. is given for the separate items, feed, labor, building charge, cow charge and miscellaneous cost. For each group the averages of the various items are given with their percentage of the total.

Tables 3 and 4 give the annual costs per cow with totals, averages and percentages for the various items of the P.S. and P.D. groups of the Edmonton and Calgary areas respectively. Tables 5 and 6 show the costs per 100 lbs. F.C.M. with totals, averages and percentages for the various items for all the groups of both areas. Generally, as the production increased in all the groups the annual cost per cow increased but the cost per 100 lbs. F.C.M. decreased.

There was a greater variation in production per cow for the Calgary area than for the Edmonton area, but the average production was much higher

TABLE 3 - TOTAL ANNUAL COSTS PER COW

EDMONTON - P.S. 37
P.D. 1

Producer Shippers

Production Classes	No. of Farms	No. of Cows	Average Prod'n.	Cost of Feed	Cost of Labor	Cost of Buildings	Cow Cost	Miscellaneous	Annual Total Cow Cost
lb.F.C.M.			lb.F.C.M.	$	$	$	$	$	$
Under 6000	5	99	5466	35.95	6.14	5.46	5.82	17.25	66.62
6000 -8000	22	421	7023	45.64	12.79	9.41	6.47	14.60	89.01
Over 8000	10	215	8773	57.72	13.52	11.25	7.86	18.97	109.32
Average of the Group	37	735	7325	47.87	12.07	9.41	6.79	15.69	91.83
Percentage of Total Cost				52.13%	13.14%	10.25%	7.38%	17.09%	

Producer Distributors

6855	1	25	6855	72.70	7.79	7.88	4.48	12.00	104.85
Percentage of Total Cost				69.34%	7.43%	7.52%	4.27%	11.44%	

TABLE 4 - TOTAL ANNUAL COSTS PER COW

CALGARY - F. S. 18
F. D. 9

Producer Shippers

Production Classes	No. of Farms	No. of Cows	Average Prod'n.	Cost of Feed	Cost of Labor	Cost of Buildings	Cow Cost	Miscellaneous	Annual Total Cow Cost
lbs. F.C.M.			lbs. F.C.M.	$	$	$	$	$	$
Under 4000	3	80	3985	29.13	6.96	2.40	3.94	8.27	50.70
4000 -6000	7	187	5285	46.45	13.76	5.00	4.18	17.48	86.87
6000 -8000	5	153	7270	51.20	8.29	6.23	6.24	14.60	86.32
Over 8000	3	74	8975	46.89	7.42	5.46	5.30	13.99	79.16
Average of the Group	18	494	6816	45.18	9.07	5.03	4.98	13.27	76.49
Percentage of Total Cost				59.07%	11.81%	6.57%	6.51%	16.04%	

Producer Distributors

4000 -6000	5	67	5329	59.88	18.41	6.49	5.34	10.49	101.01
6000 -8000	3	56	7320	83.98	18.72	4.59	4.48	30.43	142.70
Over 8000	1	18	8720	82.89	18.39	3.72	4.79	30.99	141.38
Average of the Group	9	143	65.65	70.01	14.68	5.74	3.98	22.11	126.49
Percentage of Total Cost				55.15%	11.35%	4.00%	3.80%	22.08%	

TABLE 5-AVERAGE COST OF PRODUCING 100 LBS. F.C.M.

EDMONTON - P.S. 37
P.D. 1

Producer Shippers

Production Classes lbs. F.C.M.	No. of Farms	No. of Cows	Average Prod'n. lbs.F.C.M.	Cost of Feed $	Cost of Labor $	Cost of Buildings $	Cow Cost $	Miscellaneous Cost $	Total Cost $
Under 6000	5	99	5466	0.776	0.118	0.100	0.107	0.242	1.543
6000 -8000	22	421	7033	0.650	0.179	0.125	0.086	0.195	1.875
Over 8000	10	215	8773	0.658 (1.669)	0.145	0.128	0.086	0.216	1.233
Average of the Group	37	735	7325	0.653	0.162	0.120	0.093	0.214	1.242
Percentage of Total Cost				52.58%	13.04%	9.66%	7.49%	17.23%	

Producer Distributors

6855	1	25	6855	1.107	0.107	0.115	0.065	0.149	1.543
Percentage of Total Cost				71.74%	6.93%	7.45%	4.21%	9.67%	

TABLE 6 - AVERAGE COST OF PRODUCING 100 LBS. F.C.M.

CALGARY - P.S. 18
P.D. 9

Producer Shippers

Production Classes	No. of Farms	No. of Cows	Average Prod'n.	Cost of Feed	Cost of Labor	Cost of Buildings	Cow Cost	Miscellaneous Cost	Total Cost
lbs. F.C.M.			lbs.F.C.M.	$	$	$	$	$	$
Under 4000	3	80	3825	.762	.177	.063	.103	.316	1.421
4000 -6000	7	187	5285	.379	.263	.095	.079	.215	1.531
6000 -8000	5	153	7270	.704	.116	.085	.035	.300	1.190
Over 8000	3	74	8975	.522	.080	.061	.061	.155	.880
Average of the Group	18	494	6216	.727	.149	.081	.080	.197	1.254
Percentage of Total Cost				58.91%	12.07%	6.56%	6.48%	15.98%	

Producer Distributors

4000 -6000	5	67	5520	1.134	.252	.128	.068	.347	1.909
6000 -8000	3	58	7320	1.146	.241	.063	.061	.525	2.036
Over 8000	1	18	9720	.721	.125	.077	.050	.354	1.327
Average of the Group	9	143	6565	1.067	.218	.086	.060	.471	1.870
Percentage of Total Cost				56.80%	12.44%	4.57%	3.19%	25.04%	

for both the P.S. and P.D. groups of the Edmonton area. The average valuation per cow was also higher for the P.S. of the Edmonton area as compared with the P.S. of the Calgary area, i.e., $49.00 as compared to $39.00. The greater stability and suitability of the dairying in the Edmonton area as compared with the Calgary area probably indicates the reason there are higher producing cows and higher valued cows in the Edmonton district.

The average annual total cost per cow was $91.83 for the Edmonton P.S. group and $76.49 for the Calgary P.S. group. Each of the individual items for the cows in the Edmonton area was consistently higher than for the cows in the Calgary area. This indicates the dairymen who had a higher production and therefore a greater income from milk gave more feed and care to their dairy cows than the low producer, and also had more valuable buildings and dairy cows. The higher average production per cow for Edmonton P.S. as compared to the average production for the Calgary P.S. was indiredtly the main reason why the Edmonton P.S. annual total cow costs were high. In the Edmonton P.S. group there was no class below 4000 lbs., while in the Calgary P.S. there were three producers in this class. This would tend to give Calgary P.S. lower average annual total cow costs than for Edmonton P.S. However, when the similar classes in the Edmonton and Calgary areas were compared, annual cow costs were still higher for the Edmonton P.S.

Even though the average value of hay in Calgary was $8.64 per ton and $6.69 in Edmonton and labor was worth $ .081 per hour in Calgary and $ .0695 in Edmonton, still the Edmonton P.S. had the higher annual total cow costs because their average production was higher, which caused these producers to use more feed and labor.

It has been previously brought to the reader's attention that the

higher valuation of cows and buildings in the Edmonton area gave a higher cow cost and building charge than for the Calgary area. This is clearly demonstrated in the tables. The average building cost per cow for the Edmonton P.S. was $9.41 as compared to $5.03 for Calgary and the annual cow cost was $6.79 and $4.98 respectively. Further and more conclusive proof of this point is given by comparing the figures for these items for the corresponding classes of the different areas. It can be noted that the costs are consistently higher for the classes in the Edmonton area. For example, in the last class of the P.S. of both areas, the building and cow costs were $11.25 and $7.86 respectively for Edmonton, and $5.46 and $5.50 for Calgary.

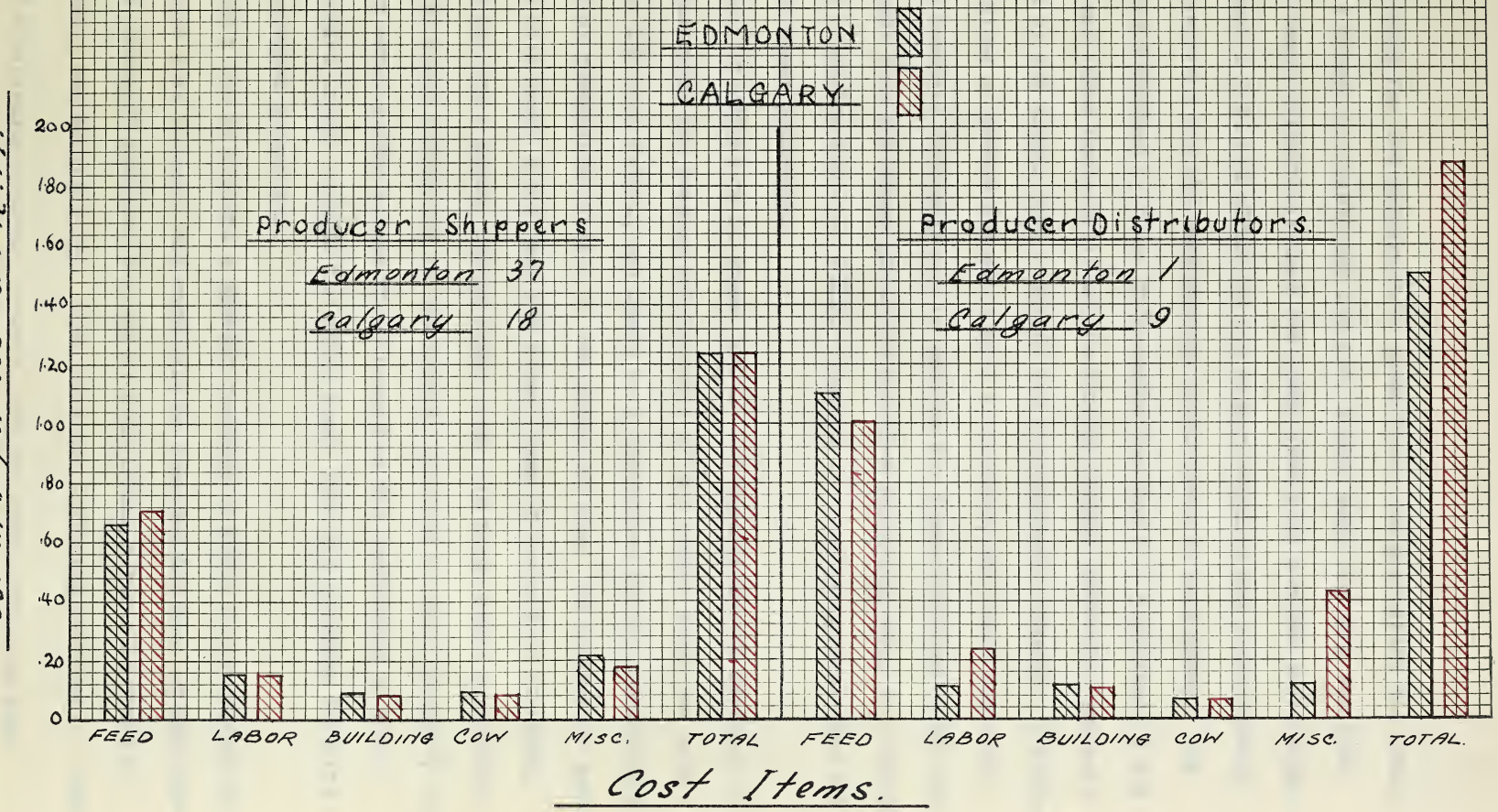
For the P.D. in Calgary the variation of the annual total costs per cow was from $101.61 to $149.70 with the average at $123.49. The one Edmonton P.D. had an annual total cost per cow of $104.85.

The second class of the Calgary P.D. had a much higher cost than either of the other classes due primarily to a higher feed cost - $83.93 as compared to $62.89 and $59.88 for the two adjacent classes. This wide difference in feed costs will be explained later.

The average cost per 100 lbs. F.C.M. (Tables 5 and 6) was approximately $1.24 for both the Edmonton and Calgary P.S. For the P.D. the average cost was much higher, $1.88 for Calgary P.D. and $1.54 for the one Edmonton P.D. The reason for the higher production costs of the P.D. will become more apparent as the analysis proceeds. It may, however, be mentioned that there was a tendency for a higher feed, labor and miscellaneous cost for the P.D. group, which was due indirectly to a relatively higher selling price received for the milk sold by this group.

Graph 1 illustrates the relationship between the cost per 100 lbs. F.C.M. of the P.S. and P.D. of both areas. It was expected, since Edmonton P.S. had a higher average production, they would have the lower cost per 100

Itemized Cost of Production of 100 lbs. F.C.M. in Edmonton and Calgary Areas.



lbs. F.C.M. than for the Calgary P.S. group where the production was lower. Actually, as shown, the costs per 100 lbs. F.C.M. were the same for both areas. The Graph illustrates that the lower feed cost per 100 lbs. F.C.M. for the Edmonton P.S. was offset by the higher building and miscellaneous cost which accounts for the same average total cost for both areas. The question arises whether a higher milk production would be justified if the lower feed and labor costs which accrue through higher production are more than offset by the higher cow, building and miscellaneous charges. A higher production gives a greater volume of milk to be sold, and hence the total net profits received from milk may be greater for those producers with high producing cows than for those producers with low producing cows, even though the cost of producing 100 lbs. F.C.M. is equal to or slightly less than the cost for the lower producers.

Further investigation of these tables, and especially the Edmonton P.S. group, demonstrates the inverse relationship of the annual total cow cost to the cost per 100 lbs. F.C.M., and leads to a discussion of the relationship of the cost of production of milk to the yield per cow. As production goes up there is more feed, labor, and the other items of production involved, which gives the cow a higher annual total cost. If these added costs were more than the added income due to the greater quantity of milk produced, then the producer would suffer a loss from increasing the production of milk, but if the added income exceeds the added cost, then the producer benefits from the increased production.

Forcing a cow to produce a greater quantity of milk, by increasing the feed allowance does not mean the cost will be less per 100 lbs. of milk produced. The "forcing" involves the law of diminishing returns as found by Ezekiel, McNall and Morrison (8). They make the following statement: "There were marked diminishing returns, however, for the herds producing more

than 7000 lbs.".

It can be noted in Tables 5 and 6 that the cost per 100 lbs. F.C.M. continues to decrease as production increases. The decrease is more uniform for the Edmonton P.S. than for either of the Calgary groups. As production increased over 7000 lbs. there was not sufficient increase in the cost of production of 100 lbs. F.C.M. to indicate that diminishing returns had set in. Apparently the production could be increased still further without increasing the costs per 100 lbs. F.C.M.; however more data would be necessary to find how high production could be increased in this area to obtain the lowest cost per 100 lbs. F.C.M. There is, however, another point of view worthy of consideration. The cows in the different classes and within each class, differ in their inherent ability to produce milk. For those cows with low inherent ability, diminishing returns would set in at a lower production level than for those cows with a greater inherent ability to produce milk.

According to a study conducted by Craig (45) who analysed these same records by a different method, those producers making a profit on their total farm industry were predominately P.D. Only one of the eighteen P.S. in Calgary realized a profit, while five of the nine P.D. were in the profit group. In the Edmonton area only eight of the thirty-nine P.S. received net returns. The one Edmonton P.D. obtained a large net return. In every case those P.S. making a profit had a lower net return than the P.D. who were in the profit group. The P.D. had practically no surplus, while the P.S. sold from 20% to 40% of their milk at surplus milk prices. This fact apparently gave the P.D. more incentive to increase production than those whose net income per 100 lbs. of milk was much lower. Hence the profit group,

as illustrated by the P.D., attempted to secure and maintain a high production by giving more feed and care to their cows, even though this practice increased their annual cow costs and cost per 100 lbs. F.C.M. Thus, while the total costs per 100 lbs. F.C.M. were much higher for P.D. than P.S., the production per cow was not on the average any greater, and it was considerably less than the Edmonton P.S. This indicates that the cows of the P.D. did not, as a whole, have the inherent ability to produce milk as cheaply as the cows of the P.S. In other words, the P.D. had a tendency to feed more grain and hay than their cows could utilize most efficiently.

Comparing corresponding production classes between the different groups, (Tables 5 and 6) show higher total costs for the P.D. Apparently diminishing returns had set in for these P.D. classes as compared with the P.S. classes. The cows of the corresponding classes, however, may not be of similar inherent ability. It is impossible, then to compare different groups of cows with different inherent ability. The general point of diminishing returns may be arrived at for any group of cows, but varies for the individuals of that group, and would not necessarily be the same for any two groups. As the production goes up the annual cow costs go up, but the cost per 100 lbs. F.C.M. goes down until the point of diminishing returns is reached. This point of diminishing returns varies with the inherent capacity of the cows to produce milk.

It was shown that the yield per cow had a direct influence on the cost of milk production. Selby, Burrier and Brandt (16) confirm this by stating that the yield per cow is the outstanding factor affecting the cost of producing milk. Other workers came to the same conclusion (16), (2), (5), (8). The production, however, is in turn dependent on and influenced by many other factors, such as feed, labor, inherent capacity of cows, season of

freshening, etc. These factors will be more fully discussed in the following sections.

FACTORS RELATED TO THE YIELD OF MILK

Of the various factors, feed, labor, season of freshening, value and age of cows, that affect the yield of milk per cow, feed is usually regarded as having the greatest influence. Hence it will be considered first among the above factors that are related to or influence the yield per cow.

Feed

There are four main classes of feed, according to Selby, Burrier and Brandt (16), concentrates, succulents, hay and pasture. These four classes of feed will be individually related to production. Finally they will all be grouped together as T.D.N. (Total Digestible Nutrients) and the actual T.D.N. contained in these feeds, along with the theoretical T.D.N. will be related to production. Also some reference will be made to the nutritive ratio of the rations.

Concentrates

From the standpoint of quantity and cost, grain was the main concentrate fed by the dairymen in the two areas studied - Tables 7 and 8. There was, however, a significant amount of protein rich supplements fed in the Calgary area and a small quantity in the Edmonton district, making up approximately 15% of the concentrates in the former city and 10% in the latter. The P.S. of Calgary fed only about one-half as much protein rich supplements as the P.D. of that area. A small amount of oil-cake was fed in both areas.

TABLE 7 - NUMBER OF POUNDS OF GRAIN AND OTHER CONCENTRATES FED ANNUALLY PER COW

EDMONTON - P.S. 37
P.D. 1

Producer Shippers

Production Classes	No. of Farms	No. of Cows	Oats	Barley	Wheat	Total Grain	Bran	Oil-cake	Concentrates Fed per 100# F.C.M.
lbs.F.C.M.			lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Under 6000 lbs.	5	99	808.	---	---	808.	286.	---	13
6000 -8000 lbs.	22	421	2136.	288.	82.	2440.	247.	20.	38
Over 8000 lbs.	10	215	2500.	217.	298.	3015.	255.	13.	37
Average of the Group	37	735	2064.	228.	108.	2420.	240.	17.	37

Producer Distributors

8855 lbs.	1	25	2108.	----	----	2108.	200.	80.	35
Average of the Group	1	25	2108	----	----	2108.	200.	80.	35

TABLE 8 - NUMBER OF POUNDS OF GRAIN AND OTHER CONCENTRATES FED ANNUALLY PER COW

CALGARY - F. B. 18
F. D. 9

Producer Shippers

Production Classes	No. of Farms	No. of Cows	Oats	Brewer's Grain (dry basis)	Other Grain	Total Grain	Bran	Oil-Cake	Concentrates Fed per 100 lbs. F.C.M.
Lbs. F.C.M.			lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Under 4000	3	30	789.	54.	675.	1518.	56.	----	41
4000 -6000	7	127	1425.	13.	209.	1635.	894.	----	42
6000 -8000	5	155	1755.	1260.	----	2845.	706.	----	46
Over 8000	3	74	1284.	371.	81.	1736.	496.	----	24
Average of the Group	18	404	1365.	459.	235.	2057.	400.	----	39

Producer Distributors

4000 -6000	5	67	402.	292.	18.	708.	492.	419.	30
6000 -8000	5	58	152.	2127.	---	2279.	868.	9.	42
Over 8000	1	18	---	----	---	----	3800.	---	30
Average of the Group	9	143	250.	998.	8.	1256.	996.	197.	37

Of the total amount of grain fed by the Edmonton P.S., 86% was oats, while in the Calgary area only 39% of the total grain was oats. This was due to the fact that large quantities of coarse grain were grown in the Edmonton district, while in the Calgary area there were less coarse grains grown nearby and also Brewer's grain was available in large quantities in this area. Some dairymen in the Calgary area fed up to 75% of Brewer's grain in their concentrated mixture. There was little or no difference in the quantities of concentrates fed per 100 lbs. F.C.M. between the P.S. and P.D. of either area. There was a fairly close relationship between concentrates fed and yield per cow. For the Edmonton P.S., as the production increased (Table 7) there were more total concentrates fed per cow. The amount fed for 100 lbs. F.C.M. was least for the first class, and much higher for the other two classes, but it will later be shown that this low concentrate consumption of the first class was offset by a higher roughage consumption per 100 lbs. F.C.M.

For both the Calgary P.S. and P.D. groups (Table 8), the amount of concentrates fed per cow also increased as production increased. There appeared, however, to be little if any relation between the yield per cow and the number of pounds fed per 100 lbs. F.C.M. for these two groups. The average amounts of concentrates fed per 100 lbs. F.C.M. were between 33 to 37 lbs. for all four groups. The results of other workers (10), (14), (1), found that from 32 to 39 pounds of grain were the average amounts fed per 100 lbs. of milk produced in the areas studied. The above figures show that as the production increased there was a tendency for the dairyman to feed concentrates more liberally per cow, although there was little or no tendency for the amounts of concentrates fed per 100 lbs. F.C.M. to increase as the production increased. Similar results were obtained in the

investigations carried out by Dow (14) and Morrison (9).

Hay

There were several kinds of hay fed in both areas. It will be noted in Table 9 that oat sheaves was the most common and comprised 80% of the total hay fed by the Edmonton P.S. For Calgary P.S., as shown in Table 10, it made up 66% of the total, but for the P.D. of that area, it constituted only about 40% of the total roughage. Prairie hay made up the bulk of the remaining roughage, being 53% of the total for the Calgary P.D. "Other hay" includes alfalfa, brome, timothy, etc., which constituted only a small proportion of the total hay fed. For both the P.S. groups there was a steady increase in the amount of hay fed as production increased. The Edmonton P.S. group had the greater variation, being from 4676 lbs. to 7386 lbs. per cow, while the Calgary group was only from 5300 lbs. to 5730 lbs. This shows the Edmonton P.S. fed hay more liberally to the higher producing cows than to the lower producing cows. The fact that the Calgary P.S. did not feed as liberally to their high producing cows accounts for the wider variation in the hay consumed per 100 lbs. F.C.M. in this area. For the Edmonton P.S. group there was sufficient increase in hay consumed for the higher producing classes, which resulted in a more uniform hay consumption per 100 lbs. F.C.M.

The P.D. of both areas, as shown in Tables 9 and 10, fed considerably more hay than did either of the P.S. groups. For the P.D. of Calgary the average was 123 lbs. per 100 lbs. F.C.M. as compared to an average of 88 lbs. for Calgary P.S. The one Edmonton P.D. fed 196 lbs. per 100 lbs. F.C.M. as compared to the average of 81 lbs. fed by the P.S. of that area. This wide difference for the Edmonton area should not be given too much consideration since it was based only on the estimate of one P.D.

TABLE 9 - NUMBER OF POUNDS OF HAY FED ANNUALLY PER COW

AND PER 100 LBS. F.C.M.

EDMONTON - P.S. 37
P.D. 1

Producer Shippers

Producer Classes	No. of Farms	No. of Cows	Oat Sheaves	Prairie Hay	Other Hay	Total Hay	Total Hay per 100 lbs. F.C.M.	Value of Hay per Cow
lbs. F.C.M.			lbs.	lbs.	lbs.	lbs.	lbs.	$
Under 6000 lbs.	5	99	3556.	404.	727.	4687.	86.	14.30
6000 -8000 lbs.	22	421	4470.	518.	494.	5482.	78.	16.00
Over 8000 lbs.	10	215	5944.	1098.	344.	7386.	84.	20.00
Average of the Group	37	735	4776.	672.	482.	5932.	81.	16.85

Producer Distributors

6855 lbs.	1	25	12640	-----	800.	13440	196.	54.70
Average of the Group	1	25	12640	-----	800.	13440	196.	54.70

TABLE 10 - NUMBER OF POUNDS OF HAY FED ANNUALLY PER COW

AND PER 100 LBS. F.C.M.

CALGARY - F.S. 18
F.D. 9

Producer Shippers

Producer Classes	No. of Farms	No. of Cows	Oat Sheaves	Prairie Hay	Other Hay	Total Hay	Total Hay per 100 lbs. F.C.M.	Value of Hay per Cow
lbs. F.C.M.			lbs.	lbs.	lbs.	lbs.	lbs.	$
Under 4000	3	80	2650.	1150.	1500.	5300.	138	14.11
4000 -6000	7	187	3444.	577.	1476.	5497.	104	25.25
6000 -8000	5	153	4340.	170.	993.	5503.	76	25.67
Over 8000	3	74	3784.	1649.	297.	5770.	64	26.54
Average of the Group	18	494	3644.	704.	1154.	5502.	88	24.00

Producer Distributors

4000 -6000	5	67	3522.	1552.	1075.	6149.	115	31.47
6000 -8000	3	58	3379.	6897.	69.	10345.	141	47.00
Over 8000	1	18	1111.	6667.	-----	7778.	90	38.29
Average of the Group	9	143	3161.	4564.	531.	8056.	123	38.90

Munger, (1) and Neethling (10), found 96 and 55 lbs. respectively as the average number of pounds of hay fed per 100 lbs. F.C.M.

The coefficient of correlation was calculated to show the relations between grain and hay to milk production. It was found to be .40 and .17 respectively, which is indicative of a closer relation between grain and yield than between hay and yield. These figures show that the dairyman tended to feed more grain but similar amounts of hay as the production increased. This is in accordance with the feeding standards which state that it is necessary to feed a higher proportion of grain to heavier producing cows.

Succulents

Silage and potatoes made up the bulk of the succulents fed in the Edmonton area. The remainder consisted mostly of turnips and other roots. Very little was consumed in the Calgary district. Approximately 40% of the Edmonton P.S. fed succulents to their herds, while in the Calgary P.S. and P.D. groups, there were only about 20% of the dairymen feeding succulents. This is probably due to the fact that Edmonton is a more intensive farming area, and more succulents such as potatoes, roots and silage crops are grown than in the less diversified Calgary area.

Tables 11 and 12 show that as the production increased there was a steady decrease in the amount of succulents fed per cow per 100 lbs. F.C.M. In the literature reviewed, succulent foods were regarded as being desirable in a dairy ration, and were generally associated with intensive feeding practices, but there was little universal agreement whether any relation existed between succulents and yield per cow. In this study, there appears to be no reason why the lower producers fed more succulents to their

TABLE 11 - SUCCULENTS AND MINERALS FED ANNUALLY PER COW

EDMONTON - F.S. 37
F.D. 1

Producer Shippers

Production Classes lbs. F.C.M.	No. of Farms	No. of Cows	Succulents lbs. per Cow lbs.	Succulents per 100 lbs. F.C.M. lbs.	Minerals lbs. per Cow lbs.	Salt lbs. per Cow lbs.
Under 6000 lbs.	5	99	1778	32	--	64
6000 -8000 lbs.	22	421	1193	17	3	69
Over 8000 lbs.	10	215	530	7	13	67
Average of the Group	37	735	1078	15	5	68

Producer Distributors

6855 lbs.	1	25	---	---	--	120
Average of the Group	1	25	---	---	--	120

TABLE 12 - SUCCULENTS AND MINERALS FED ANNUALLY PER COW

CALGARY - P.S. 18
P.D. 9

Producer Shippers

Production Classes	No. of Farms	No. of Cows	Succulents lbs. per Cow	Succulents per 100 lbs. F.C.M.	Minerals lbs. per Cow	Salt lbs. per Cow
lbs. F.C.M.			lbs.	lbs.	lbs.	lbs.
Under 4000	3	80	---	--	1	15
4000 -6000	7	187	26	.5	2	81
6000 -8000	5	153	10	.1	5	54
Over 8000	3	74	---	--	8	86
Average of the Group	18	494	13	.2	4	63

Producer Distributors

4000 -6000	5	67	157	2.9	-	106
6000 -8000	3	58	10	.1	-	176
Over 8000	1	18	---	---	-	56
Average of the Group	9	143	76	1.2	-	122

cows than did the higher producers. White and Johnson (47) came to the conclusion that succulents did not increase the yield per cow except where the cows were not receiving sufficient water.

Minerals

There were very little minerals, except salt, fed in either of the two areas. In the Edmonton P.S. group approximately 30% of the dairymen fed a mineral mixture, while in the Calgary P.S. group there were only 20% of the dairymen feeding a mineral mixture.

In Tables 11 and 12 it is shown that as the yield per cow increased in the P.S. groups, the amount of mineral mixture fed per cow increased. No minerals except salt were fed to the lowest production class of the Edmonton P.S. This indicates that the higher producers followed better feeding practices than the lower producers. None of the P.D. of Edmonton or Calgary fed any mineral mixture except salt to their cows, which may probably be due to the fact that most of the P.D. kept their cows only for a short period of time, which would lessen their interest in the feeding of minerals.

Common salt was universally fed to the cows of all groups. Both of the P.D. groups of Edmonton and Calgary fed considerably more salt than the P.S. groups. There appears to be no reason for this, as both groups were feeding well over the amount prescribed as necessary by Larson and Putney (44), which was 30 to 40 lbs. for a thousand pound cow producing 6000 lbs. of milk annually. It is suspected that the dairymen must have included salt for other farm animals when giving the amounts consumed by the dairy cows. The average of 68 lbs. of salt for the Edmonton P.S. group showed little variation. For the Calgary P.S. group the average was only

63 lbs. per cow, but there was a much wider variation. There appeared to be no relation between the salt consumed and the yield per cow in any of the four groups.

Pasture

The type and yield of pasture varied greatly between the Edmonton and Calgary areas. Due to the climatic and soil conditions, the pasture in the Edmonton area was much more succulent and also contained more of the cultivated grasses than that of the Calgary area. In the Edmonton area, the grass was more luxuriant and less acreage was required to maintain a cow than in the Calgary area. The pasture around Calgary, due to climatic conditions, dries up usually during the latter part of July and August, which makes a shorter season in this area than in the Edmonton district. The average length of pasture season was 3.5 months for Calgary as compared with 4.6 months for Edmonton. This gave a longer dry feeding period for the Calgary producers, and consequently a greater feed cost per 100 lbs. F.C.M.

Larson and Putney (44) claim that "Pasture alone, no matter how good, does not supply enough nutrients for the high producing cow". They maintain a cow producing over 20 lbs. of milk per day should have a grain supplement.

Although no figures can be given, observations indicate that the producers in Edmonton and Calgary did not supplement pasture with grain except during the late Summer and Fall months. Generally, however, most of the cows did not yield on the average much over 20 lbs. a day. Consequently they would not require much grain to supplement their pasture.

The above discussion merely points out the difference between the

pasture of the two areas, as it was not possible to show a definite relationship between pasture and yield.

Total Feeds and T.D.N.

While the individual classes of feed may vary considerably, it is logical to assume that the total quantities of all classes of feed fed would have a closer relationship to yield than any one individual feed. In Tables 13 and 14 it is shown that the total feeds fed annually per cow for all of the groups increased as the production increased; but the amount fed per 100 lbs. F.C.M. decreased as the production increased. The average total feed consumed per 100 lbs. F.C.M. for both of the P.D. groups was much higher per cow and per 100 lbs. F.C.M. than either of the P.S. groups. This indicates more liberal feeding by the P.D., which may be accounted for by the higher income obtained by this group. The second class of the P.D. had a much higher feed consumption per 100 lbs. F.C.M. than either of the other classes. Examination of the individual producers of this class shows that one of them fed an abnormally large amount of hay, which probably accounts for the higher feed consumption per 100 lbs. F.C.M. for this class.

The whole discussion of feed, thus far, can be summed up by stating that within each group the dairyman with higher producing cows fed more feed per cow but less per 100 lbs. F.C.M. Also that those obtaining the larger income fed proportionately more feed per cow and per 100 lbs. F.C.M. than did those receiving smaller incomes.

While total feeds fed to the various groups of cows showed a relationship to the average yield of the cow, comparison on the T.D.N. basis should give more accurate results. There are however, a few limit-

TABLE 13 - TOTAL POUNDS OF FEED FED ANNUALLY, PER 100# F.C.M., PER COW, AND T.D.N. FED PER 100 LBS. F.C.M.

EDMONTON - P.S. 37
P.D. 1

Producer Shippers

Production Classes	No. of Farms	No. of Cows	Total Grain	Total Hay	Total Other Feeds	Total Minerals	Total all Feeds	Total all Feeds per 100# F.C.M.	Actual T.D.N. 100 lbs. F.C.M.	Theoretical T.D.N. 100 lbs. F.C.M.	Approximate Difference between Actual and Theoretical T.D.N.
lbs. F.C.M.			lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Under 6000 lbs.	5	99	808.	4687.	2004.	68.	7562.	172.	101.62	88.55	4.
6000 -8000 lbs.	22	421	2496.	5482.	1461.	71.	9510.	135.	97.46	83.45	14.
Over 8000 lbs.	10	215	3015.	7386.	782.	79.	11262.	123.	90.87	73.83	17.
Average of the Group	37	735	2420.	5932.	1335.	72.	9762.	133.	96.00	82.00	14.

Producer Distributors

8855 lbs.	1	25	2105.	13440.	220.	130.	15942.	230.	130.3	100.0	30.
Average of the Group	1	25	2105.	13440.	220.	130.	15942.	230.	130.3	100.0	30.

TABLE 14 - TOTAL POUNDS OF FEED FED ANNUALLY, PER 100 LBS. F.C.M.,

PER COW, AND T.D.N. FED PER 100 LBS. F.C.M.

CALGARY - F.S. 18
F.D. 9

Producer Shippers

Production Classes	No. of Farms	No. of Cows	Total Grain	Total Hay	Total Other Feeds	Total Minerals	Total all Feeds	Total all Feeds per 100 lbs. F.C.M.	Actual T.D.N. 100 lbs. F.C.M.	Theoretical T.D.N. 100 lbs. F.C.M.	Approximate Difference between Actual and Theoretical T.D.N.
lbs.F.C.M.			lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Under 4000 lbs.	3	20	1519.	5300.	56.	16.	6891.	190.	151.4	137.0	4
4000 -6000 lbs.	7	187	1935.	5497.	380.	58.	7833.	148.	102.7	100.2	5
6000 -8000 lbs.	5	153	2648.	5507.	716.	52.	8921.	125.	90.2	83.3	9
Over 8000 lbs.	3	74	1736.	5730.	405.	95.	7966.	89.	69.2	72.7	-4
Average of the Group	18	434	2057.	5503.	413.	67.	8019.	139.	96.	91.	5

Producer Distributors

4000 - 6000 lbs.	5	67	706.	6149.	1067.	106.	8030.	151.	115.2	100.1	15
6000 - 8000 lbs.	6	68	2479.	10345.	874.	176.	13874.	187.	114.1	80.1	37
Over 8000 lbs.	1	18	---	7778.	3300.	55.	11133.	138.	87.3	74.2	13
Average of the Group	9	143	1593.	8956.	1074.	128.	10711.	162.	118.	85.	34

ations to using the T.D.N. as the basis for comparison with the milk yield. When the T.D.N. is considered, it does not include the nutritive ratio of the feeds nor palatability nor bulkiness of the ration, all of which have an important bearing on the suitability of the dairy ration. Despite these disadvantages, the actual T.D.N. fed is of practical value to the producer when it is compared with the theoretical or required amount of T.D.N., indicating to the producer whether more feed is being fed than is required.

The theoretical T.D.N. was based on the Morrison feeding standards (43). The amount of T.D.N. required for maintainance of the cow and for the milk produced were added together to give the total T.D.N. required by the cow for the year. This T.D.N. required was divided by the number of 100 lbs. F.C.M. produced per cow to give the theoretical or required amount of T.D.N. which was required by that cow to produce 100 lbs. F.C.M., and this can be compared with the T.D.N. actually fed. Consequently if the theoretical T.D.N. required for 100 lbs. F.C.M. was lower than the actual amount fed it would indicate that the cows did not efficiently utilize the extra amount fed for the milk produced. This probably was due either to their inherent inability to utilize all the extra T.D.N. fed, or the ration may not have been suitable in kinds of feed or amounts of digestible proteins.

It can be noted in Tables 13 and 14 that there was a wide variation for all the groups between the actual amounts of T.D.N. fed and the theoretical amounts of T.D.N. required for 100 lbs. F.C.M. The tables also show that for every increase in production there was a decrease in both the actual amounts of T.D.N. fed and the theoretical amounts of T.D.N. required per 100 lbs. F.C.M. One exception was the second class of the Calgary P.D.

which fed more per 100 lbs. F.C.M. than the preceding class. This was due to one of the dairymen of this class apparently feeding an abnormally large amount of hay to his cows. It is apparent then, that as the quantity of milk produced is increased, there is a lesser proportion of the total amount of T.D.N. used for maintainance of the cow and a greater proportion used for each 100 lbs. F.C.M. produced. Differences in the inherent ability of a cow, however, will also affect the amount of T.D.N. required as the yield per cow increases.

An important consideration to the producer is the difference between the actual amount of T.D.N. fed per 100 lbs. F.C.M. produced and the required amount for that same 100 lbs. F.C.M., thus indicating whether more or less feed is being fed than is required. For the Edmonton P.S. group the difference between the actual and theoretical T.D.N. increased from 4 to 17 lbs. as the production increased. Or as the production increased the producers had a tendency to feed more and more T.D.N. over and above the required amount for that yield of milk. Even though there was a greater spread between actual and required amounts of T.D.N. as production increased, nevertheless the dairymen with the higher producing cows fed less per 100 lbs. F.C.M. than the dairymen with the lower producing cows, or in other words, the higher producing cows utilized the feed more efficiently than did the lower producing cows.

For the P.D. groups the difference between actual and theoretical T.D.N. was much higher than for either of the P.S. groups due to the larger income of these P.D. groups. The Calgary P.S. group had the least difference between actual and theoretical T.D.N. per 100 lbs. F.C.M. than either of the other groups, probably due to the smaller income per cow of this group as compared to similar classes in the Edmonton P.S. or Calgary P.D. groups where larger incomes were being secured per cow from the sale of milk.

It has been shown that the P.D. overfed and consequently had a greater difference between actual and theoretical T.D.N. than the P.S. groups. It was also pointed out that the higher income of this group was the main cause for the more liberal feeding. There is however, another contributing factor. The P.D. had to produce a uniform supply of milk during the whole year in order to meet their daily demand for milk. This would entail more feed during the slack seasons and may cause a "forcing" of the cows at certain times of the year in order that the supply be kept up to the daily requirements.

For the Edmonton P.S. the largest group of the two areas, the simple correlation between the yield per cow and the T.D.N. fed per cow was .34, which indicates that as production increased there was a tendency to feed the cows more liberally. Ezekiel, McNall and Morrison (8) found the correlation between the milk production and T.D.N. fed to be .37 for one study and .22 for another. They considered these two figures to be significant of a relation between production and T.D.N. This gives added proof that there was a fairly close relationship between the T.D.N. fed and the yield per cow.

From what has been shown with regard to feed it may be concluded that as the production goes up, more T.D.N. was fed per cow but less T.D.N. was fed per 100 lbs. F.C.M. produced. As production increased, there was a greater spread between actual and theoretical T.D.N. fed per 100 lbs. F.C.M. produced and also where incomes were higher, as shown between the P.D. and P.S. groups, there was a still greater spread between actual and theoretical T.D.N. This spread leads to the conclusion that as production

or incomes per cow increased, there would be a greater tendency to augment the feed allowance to the cows beyond the point where they produced the milk most efficiently.

Nutritive Ratio

A thorough analysis of the nutritive ratio has not been attempted in this study. However, for the Edmonton P.S. group, the nutritive ratio was roughly calculated for each class and found to be 1:7.9, 1:7.6, and 1:7.8 respectively from the lowest class to the highest, with the average at 1:7.8. This means for every pound of digestible protein fed, 7.8 pounds of carbohydrates and fat were also fed. The uniformity of the nutritive ratio for these classes indicates the dairymen with the higher producing cows did not feed proportionately more protein in these two areas. Henry and Morrison (43) state that a 1200 pound cow producing 30 lbs. of 3.5 per cent milk a day should receive a ration with a nutritive ratio not less than 1:6.1 to 1:7.2. Ezekiel, McNall and Morrison (8) concluded that as the nutritive ratio is narrowed down to 1:7, the production increased per unit of T.D.N. fed, but beyond that point, further narrowing of the nutritive ratio of the ration failed to show any response in the milk production. Over one-half of the producers in that area (Wisconsin), however, had a nutritive ratio over 1:8.5.

Since the nutritive ratio found in the Edmonton area does not differ widely from a nutritive ratio of 1:7, there would probably have been very little increase in milk production had the dairymen fed a larger proportion of protein.

Labor

The actual and theoretical amounts of labor were calculated for the various production classes. In this study the actual number of hours of labor was obtained and from these the number of hours of labor used for 100 lbs. F.C.M. were calculated - Tables 15 and 16. The theoretical or required amount of labor was based on the results of Venstrom and Headley (15). The method of calculation has already been outlined under "Method of Analysis". No study was made of the efficiency of the labor used by the dairymen.

The tables show that as the production of milk increased there was generally less actual and required labor per 100 lbs. F.C.M. Larson and Putney (44) and Morrison (9) found similar results. The theoretical amount of labor did not vary for corresponding classes, unless there was a variation in size of the herd, which accounts for the differences among the classes of the Calgary P.S. group.

For the actual amount of labor per 100 lbs. F.C.M., class 2 of the Edmonton P.S. and class 2 of the Calgary P.D. are both higher than the following class. In both of these cases the size of the herd was smaller than the preceding class. These results indicate that size of herd also affects the amount of labor used per 100 lbs. F.C.M., less labor being used with the large herds than with the smaller herds. This confirms the results of Venstrom and Headley (15), who, as has been previously shown, found that larger herds required less labor per 100 lbs. F.C.M. than smaller herds. Stephens (17) and Pond and Ezekiel (11) both assert that management or efficiency of labor had an important influence on the amount of labor used for milk production. There appear, then, to be three recognized factors, yield per cow, size of herd, and efficiency of labor, that influenced the amount of labor required to

TABLE 15 - VALUE OF LABOR PER HOUR AND HOURS OF ACTUAL AND THEORETICAL LABOR USED PER 100 LBS. F.C.M.

EDMONTON - F.S. 23
F.D. 1

Producer Shippers

Production Classes	No. of Farms	No. of Cows	Average Size of Herd	Average Value per Hour	Actual Labor per 100 lbs. F.C.M.	Theoretical Labor per 100 lbs. F.C.M.	Average Cost per 100 lbs. F.C.M.
lbs. F.C.M.				$	Hrs.	Hrs.	$
Under 6000 lbs.	3	59	20	0.058	2.02	2.50	0.118
6000 - 8000 lbs.	18	327	18	0.083	2.15	1.72	0.179
Over 8000 lbs.	7	127	18	0.086	1.68	1.41	0.145
Average of the Group	28	513	18	0.081	2.07	1.80	0.168

Producer Distributors

6855 lbs.	1	25	25	0.067	1.60	1.70	0.107
Average of the Group	1	25	25	0.067	1.60	1.70	0.107

TABLE 16 - VALUE OF LABOR PER HOUR AND HOURS OF ACTUAL AND THEORETICAL LABOR USED PER 100 LBS. F.C.M.

CALGARY - F.S. 9
I.D. 8

Producer Shippers

Production Classes lbs.F.C.M.	No. of Farms	No. of Cows	Average Size of Herd	Average Value per Hour $	Actual Labor per 100 lbs. F.C.M. Hrs.	Theoretical Labor per 100 lbs. F.C.M. Hrs.	Average Cost per 100 lbs F.C.M. $
Under 4000lbs.	2	55	27	0.0547	3.23	2.97	0.177
4000 -6000 lbs.	3	69	23	0.0897	2.93	2.37	0.265
6000 -8000 lbs.	3	118	39	0.0705	1.65	1.52	0.116
Over 8000 lbs.	1	17	17	0.0576	1.55	1.64	0.089
Average of the Group	9	259	28	0.0695	2.15	1.92	0.149

Producer Distributors

4000 -6000 lbs.	5	67	13	0.0794	3.17	2.51	0.252
6000 -8000 lbs.	2	18	9	0.0753	3.20	1.91	0.241
Over 8000 lbs.	1	18	18	0.1244	1.55	1.51	0.193
Average of the Group	8	103	13	0.897	2.77	2.15	0.238

produce 100 lbs. F.C.M.

The P.D. of Calgary use more labor for 100 lbs. F.C.M., both actual and theoretical, than either of the P.S. groups. The smaller size of herd and higher income of this group were probably the main contributing factors for the higher labor requirement of this group.

The above discussion shows that as either production, size of herd, or efficiency of labor was increased, there was a decrease in the number of hours of labor required for 100 lbs. F.C.M. In a later section the value of the labor used to produce 100 lbs. F.C.M. will be discussed from the standpoint of variability.

Value of Cows

The value of the cows for the different groups and classes is given in Table 17.

TABLE 17 - RELATION OF VALUE PER COW TO YIELD PER COW

Production Classes ~~lbs.F.C.M.~~	Edmonton No. of Cows	Edmonton Value per Cow	Edmonton Ratio Value per Cow to yield	Calgary No. of Cows	Calgary Value per Cow	Calgary Ratio Value per Cow to yield
Producer Shippers						
Under 4000	--	--	--	80	32	.008
4000 -6000	99	47	.009	187	33	.006
6000 -8000	421	48	.007	153	50	.007
Over 8000	215	63	.007	74	44	.005
Average of the Groups	735	49	.007	494	39	.006
Producer Distributors						
Under 6000	--	--	--	67	27	.005
6000 -8000	25	36	.005	58	35	.005
Over 8000	--	--	--	18	35	.004
Average of the Groups	25	36	.005	143	31	.005

There was a marked tendency for the value of the cows to increase as the yield per cow increased. Class 3 of the Calgary P.S. including only five dairymen was the only exception to the above rule. However, the tables show that the dairymen did not increase the value of their cows in the same proportion that production increased, but tended to undervalue the higher producing cows. This would result in a lower cow charge per 100 lbs. F.C.M. for the higher producing cows than for the lower producing cows. Similar results were found in other studies (17), (16), (8).

Season of Freshening and Age of Cow

There was very little data collected pertaining to the season of freshening and age of the cows. In both areas there was a tendency for the P.S. to have the cows freshen in the late fall, generally in October. There was however, considerable variation among the individual producers, few following the practice of having their cows freshen in the spring.

The P.D. had their cows freshen throughout the year, as they had to keep a uniform supply of milk the year round. According to the results of other investigators (8), (28), dairymen received more milk from their cows by following the practice of fall freshening than from cows that freshened at other times of the year.

The average age of the cows in these two district was between six and seven years. According to Gowen (30), (31), the age for maximum production of Holsteins and Jerseys was eight years. Since the raising of heifers is necessary for herd maintainance, an average age of six to seven years, as found in this study, appears to be close to that found in any well-managed herd.

Summary

In the foregoing discussion, the various factors influencing and relating to the yield of milk per cow have been discussed. It was shown that feed exerted the greatest influence on the production of milk in this study, and as the yield per cow increased, more feed was fed per cow but less per 100 lbs. F.C.M. As the production increased there was a tendency to feed proportionately more concentrates than hay per cow, also the higher producing cows were fed more minerals per cow than the lower producing cows. Those producers with the larger incomes per cow tended to feed their cows more liberally. These results are similar to those of other investigators (8), (11). Likewise, there was a tendency for more labor to be used as the production increased but less per 100 lbs. F.C.M. Increasing the efficiency of the labor or increasing the size of the herd also tended to lessen the amount used per 100 lbs. F.C.M. There was a fairly close relation between production per cow and value per cow. The other factors, season of freshening, age of cows, nutritive ratio, appeared to have little influence on production. However, for season of freshening and average age of cows, there was not sufficient data available to show any significant results in these two areas.

CAUSES FOR VARIATIONS IN THE VARIOUS COST ITEMS

Thus far in the study production has been related to the total cost of producing milk, and the factors influencing the yield per cow have been studied, based upon group and class averages. This section includes a study of the variability and the causes for the differences in the various cost items between individual dairymen.

Feed

It has been shown in the previous sections that feed was the most important item related to the production of milk and hence to the total cost of producing milk. In Tables 3, 4, 5 and 6 it was shown that feed constituted over 50% of the total cost of milk production. An examination of the cost of feed for the individual herds shows there was a wide variation between the individual producers. For the Edmonton P.S. the range was from $ .21 to $1.30 per 100 lbs. F.C.M. Calgary P.S. present a smaller variation, being from $ .48 to $1.08 per 100 lbs. F.C.M. The Calgary P.D. group, however, had the widest range of all, $ .40 to $2.00 per 100 lbs. F.C.M.

Tables 18 and 19 were compiled in an attempt to find out the reason for these wide variations in the cost of feed per 100 lbs. F.C.M. The records were sorted out in order of increasing cost of feed per 100 lbs. F.C.M. Other cost items relating to the same herds were also tabulated.

In the previous sections it was also pointed out that as the production increased the cost of feed per cow increased, and there was a tendency, although it was not very marked, for the cost of feed per 100 lbs. F.C.M. to go down as the production increased (Tables 3, 4, 5 and 6). In Tables 13 and 14 it was shown that as the production increased there was a marked tendency for less T.D.N. to be fed per 100 lbs. F.C.M. It appears, then, that one of the causes for the variation in the feed cost is the yield per cow. However, when the herds were classed according to feed costs per 100 lbs. F.C.M. the figures for the Edmonton P.S. show that as the cost of feed per 100 lbs. F.C.M. increased there was less than 4% variation of the yield per cow from the average. Apparently the variation in the cost per 100 lbs. F.C.M. was not due to a variation in the yield per cow in this group, for the producers tended to vary the amount of feed fed to their cows regardless of the

TABLE 18 - RELATION OF THE VARIOUS ITEMS TO COST OF FEED PER 100 LBS. F.C.M.

EDMONTON - F.S. 37

Classes of Feed Cost Per 100 lbs. F.C.M.	Average Cost of Feed per 100 lb.F.C.M.	No. of Farms	Average Yield Per Cow	Cost of Hay per 100 lbs. F.C.M.	Cost of Concentrates per 100 lb.F.C.M.	Actual T.D.N. per 100 lb.F.C.M.	Average Size of Herd	Average Value per Cow
$	$		lbs. F.C.M.	$	$	lbs.		$
Under .55	.42	14	7064	.20	.12	81.2	18	40
.55 - .75	.66	13	7438	.23	.30	95.8	19	43
Over .75	.91	10	7535	.35	.56	108.9	24	65
Average of the Group	.63 ©	37	7325	.29	.26	95.3	20	47

© Farm Average in Tables 16 to 32 inclusive

TABLE 19 - RELATION OF THE VARIOUS ITEMS TO COST OF FEED PER 100 LBS. F.C.M.

CALGARY - P.S. 18
F.D. 9

Producer Shippers

Classes of Feed Cost Per 100 lbs. F.C.M.	Average Cost of Feed per 100 lb. F.C.M.	No. of Farms	Average Yield per Cow	Cost of Hay per 100 lb. F.C.M.	Cost of Concentrates per 100 lb. F.C.M.	Actual T.D.N. per 100 lb. F.C.M.	Average Size of Herd	Average Value per Cow
¢	¢		lbs. F.C.M.	¢	¢			¢
Under .55	.51	3	7840	.38	.14	70.2	30	48
.55 - .75	.68	6	6313	.35	.33	96.5	33	35
Over .75	.90	9	5458	.47	.44	110.6	24	41
Average of the Group	.76	18	6216	.38	.32	95.9	27	50

Producer Distributors

Under .75	.58	3	7478	.31	.25	84.7	11	37
.75 - 1.00	.96	2	6387	.44	.29	96.9	22	35
Over 1.00	1.68	4	6242	.85	.45	138.5	17	23
Average of the Group	1.14	9	6565	.59	.35	118.3	16	31

production of the cows. For the Calgary P.S. and P.D. groups it is shown in Table 19 that as the cost of feed per 100 lbs. F.C.M. increased for both groups, there was a marked tendency for the yield per cow to decrease. The dairymen with the higher producing cows apparently fed their cows more efficiently, or their cows utilized the feed more efficiently, than the dairymen with the lower producing herds. In all the groups, as the cost of feed per 100 lbs. F.C.M. increased, the T.D.N. per 100 lbs. F.C.M. also increased, since both are based on the amount of feed required per 100 lbs. F.C.M.

The above discussion indicates that as the production per cow increased the cost of feed per 100 lbs. F.C.M. decreased in both Calgary groups, but in the Edmonton P.S. group the above relationship did not exist. It appears that in the Calgary area production could probably be increased still further with the lowering of feed costs per 100 lbs. F.C.M.

For the Edmonton P.S. group the variation in feed cost per 100 lbs. F.C.M. must be attributed to some other cause than to the yield per cow. The tables show that the class with the lowest feed cost in the Edmonton P.S. group had a proportionately much lower concentrate cost to hay cost per 100 lbs. F.C.M. than did the class with the highest feed costs. As the feed cost increased the amount of concentrates increased proportionately much faster than the amount of hay for 100 lbs. F.C.M. The same is true, but to a lesser extent in the Calgary P.S. group. In the Calgary P.D. group the value of hay fed per 100 lbs. F.C.M. increased faster than the value of concentrates. However, in this group there was a relatively large amount of expensive hay fed by the lower producers.

It appears then, that the tendency to feed a larger proportion of concentrates than hay was the main cause for the variation in the feed cost per 100 lbs. F.C.M. for the Edmonton P.S. group, and to a slightly less extent for

the Calgary P.S. group. The tendency to feed both more concentrates and more expensive hay in the Calgary P.D. group caused an increase in the feed cost per 100 lbs. F.C.M. in this group.

Willard (33) concluded that feeding an entirely roughage ration gave lower feed costs per 100 lbs. milk and almost as high yields per cow as when grain was fed to supplement the hay. Hampson (34) gave tables of the ratio of grain and other feed prices to the selling price of milk, and explains their use in the feeding of dairy cows. It is likely, although there are no figures to substantiate the statement, that some variation of the feed cost within the different groups was due to the dairymen giving different valuations of similar feeds fed.

The size of the herd showed little or no relation to the cost of feed per 100 lbs. F.C.M. For Edmonton P.S. the largest herd had the highest feed cost, but, for the Calgary P.S., the larger herds had lower feed costs. In both instances, however, the herds averaging twenty-four cows had the highest feed cost, and those herds below and above had lower feed costs. For the P.D. the smallest herd containing only 11 cows had the lowest feed cost of that group. In each group the variation in the size of the herd was quite small, and when this was considered along with the small number of producers in some of the classes, it was impossible to attach any significance to this factor as a means of explaining variation in the cost of feed.

Selby, Burrier and Brandt (16) found that the feed cost, along with the total cost per 100 lbs. milk, decreased as the size of the herd increased. An increase in the size of the herd from under ten to over fifty cows reduced the feed cost from $67.00 to $45.00 per cow. They attribute the lower costs to an increase in the ability of the producer with the larger herds to buy feed in greater quantities than the smaller producers. It is

doubtful if this would have any significance in these two areas, especially in Edmonton where most of the feed was home grown. In another study Neething (10) found that about twenty cows was the optimum size of herd for a farmer with 160 acres.

It seems from the results of other authorities, that wide differences in herd size does have an effect on the feed cost, but the variations in the groups under study were too small to show any variation in the cost of feed per 100 lbs. F.C.M.

The value per cow in relation to the feed cost is also shown in the tables. It may be assumed that if dairymen regarded their cows as being of high value they would have a tendency to feed their cows more liberally than dairymen who valued their cows lower. There appears, however, to be no direct relation between the value per cow and the cost of feed per 100 lbs. F.C.M., although there was quite a close relation between the value per cow and the yield per cow. Consequently, any relation between value per cow and cost of feed per 100 lbs. F.C.M. would be through the yield per cow.

There were not enough pure bred herds in the areas studied to show any significant results to feed costs. However a few will be pointed out. One pure bred herd found in the Edmonton P.S. group containing 28 pure bred Jerseys and 16 pure bred Holsteins, had an average production of only 6563 lbs. F.C.M. and a feed cost of $ .87 per 100 lbs. F.C.M. Another registered herd in the same area had an average annual production of 9468 lbs. F.C.M. and a feed cost of $ .76 per 100 lbs. F.C.M. In the Calgary P.S. group there were two producers with pure bred herds, one having an annual production of 5693 lbs. F.C.M. and feed costs of $1.02 per 100 lbs. F.C.M. The other had an average production of 5456 lbs.

F.C.M. and a feed cost of $ .54 per 100 lbs. F.C.M. These figures indicate that the pure bred herds found in these two areas did not have lower feed costs or higher productions than the average grade herds. In fact, the figures indicate that the former had higher costs than the average grade herds, while their production was not on the average any higher.

Labor

In the previous section it was pointed out that as the production, size of herd or efficiency of labor increased, less labor was required per 100 lbs. F.C.M. Also in Tables 5 and 6 it was shown that after feed, labor was the largest individual cost, comprising from 12% to 13% of the total cost of producing 100 lbs. F.C.M. For the one Edmonton P.D. however, it was only 6.67% of the total cost of producing 100 lbs. F.C.M. Feed and labor together constitute between 65% to 70% of the total cost, which corresponds very closely with the results of other workers (3), (4). The discussion of the variability of labor will be treated in a similar manner to the discussion on feed.

In Tables 20 and 21 the cost of labor per 100 lbs. F.C.M. is related to the various other items. It was necessary to make the classes slightly different in the three groups so the total number of farms would be more evenly distributed. While the average cost of labor for 100 lbs. F.C.M. varied little for the two P.S. groups, the range of $ .06 to $ .54 for the Edmonton P.S. group was greater than the range of $ .06 to $ .33 for the Calgary P.S. group. For the P.D. of Calgary the average was much higher - $ .30 for 100 lbs. F.C.M., and the range was from $ .05 to $ .48. There were two main reasons for the higher costs of this P.D. group; first, the average size of the herd was much smaller than for the P.S. groups, 13 as compared to 19 and 29 respectively for the P.S. of Ed-

TABLE 20 - RELATION OF VARIOUS ITEMS TO COST OF LABOR PER 100 LBS. F.C.M.

EDMONTON - F.S. 22

Classes for Cost of Labor per 100 lbs. F.C.M.	Average Cost of Labor per 100 lbs. F.C.M.	No. of Farms	Average Yield per Cow	Average No. of Hours per 100# F.C.M.	Average Value per Hour	Average Size of Herd	Average Value per Cow	Average Size of Farm
	$		lbs.	Hrs.	$		$	acres
Under .12	.10	8	6845	1.68	.06	22	43	410
.12 - .18	.15	12	7755	2.00	.08	20	44	242
Over .18	.22	8	7358	2.67	.11	14	44	196
Average of the Group	.17	28	7379	2.10	.08	19	47	273

TABLE 21 - RELATION OF VARIOUS ITEMS TO COST OF LABOR PER 100 LBS. F.C.M.

CALGARY - P.S. 9
P.D. 2

Producer Shippers

Classes for Cost of Labor per 100 lbs. F.C.M.	Average Cost of Labor per 100 lbs. F.C.M.	No. of Farms	Average Yield per Cow	Average No. of Hours per 100# F.C.M.	Average Value per Hour	Average Size of Herd	Average Value per Cow	Average Size of Farm
$	$		lbs.	Hrs.	$		$	Acres
Under .12	.08	3	7384	1.41	.06	37	40	287
.12 - .20	.19	3	4514	2.83	.07	22	35	453
Over .20	.30	3	5874	3.53	.09	21	33	346
Average of the Group	.19	9	5924	3.59	.07	28	37	355

Producer Distributors

Under .20	.17	2	7033	2.44	.08	16	25	25
.20 - .35	.27	3	5003	2.80	.10	19	37	27
Over .35	.41	3	5494	5.57	.08	8	35	23
Average of the Group	.30	8	6068	3.77	.09	13	32	29

monton and Calgary. Second, the cost of labor per hour was higher for the P.D. than for the P.S. The higher net income of this group probably explains the higher variation of labor, and also the tendency to use more labor for 100 lbs. F.C.M. That is, since they were realizing a profit, they would tend to use more labor as well as more feed for their cows.

It is obvious that the cost of labor for 100 lbs. F.C.M. depends upon both the amount of labor used for 100 lbs. F.C.M. and the value of labor per hour. It has already been pointed out that the number of hours of labor required for 100 lbs. F.C.M. was dependent upon three factors, - the size of the herd, the production, and the efficiency of the labor. Tables 20 and 21 show for the P.S. groups that the number of hours of labor for 100 lbs. F.C.M. decreased as the size of the herd increased. In the P.D. group the first class had a slightly smaller herd than the second class, but at the same time they had a much larger production, which probably explains the fewer hours used for 100 lbs. F.C.M. The third class, with an average herd of only six cows and a relatively small production, used the most labor for 100 lbs. F.C.M. of any class of the three groups. From the tables and discussion it appears that the larger herds used less labor and that the size of the herd was an important factor causing a variation in the amount of labor used for 100 lbs. F.C.M. Stephen's (17) found that herds ranging from twenty-four to twenty-nine cows use less labor for 100 lbs. F.C.M. than any other sized herd. But, he adds, the size of farm, amount of equipment available and managerial ability of the producer have a direct affect on the amount of labor required to produce 100 lbs. of milk. Selby, Burrier and Brandt, (16), go further than Stephens by stating that the layout of buildings and arrangement of equipment within the buildings also affects the amount of labor used for 100 lbs. F.C.M.

An analysis of the two Edmonton P.S. with the lowest cost compared with the two producers with the highest cost per 100 lbs. F.C.M. is shown in Table 22.

TABLE 22 - VARIATIONS IN THE COST OF LABOR FOR THE TWO DAIRYMEN WITH THE HIGHEST AND LOWEST LABOR COSTS IN THE EDMONTON P. S. GROUP

Labor Cost per 100 lbs. F.C.M.	Value of Barn	Size of Farm	Value of Total Farm Equipment	Production per Cow	No.of Cows	No.of Hours of labor per 100 lbs. F.C.M.	Value per Hour
$	$	acres	$	lbs.F.C.M.			$
.07	2200	211	1582	6929	25	1.33	.05
.53	1350	285	727	7400	18	3.04	.18

From these figures it appears that labor was more efficient where the herd was larger and where the barns and equipment were better. This is in agreement with the previously mentioned investigators (17), (16). The production, however, was higher in the latter class, although the difference was not great. Both classes used about one-third of hired labor and two-thirds family labor, but the two producers of the latter class valued their own labor at a much larger figure than those of the former class.

Referring again to Tables 20 and 21, it is evident that for the two P.S. groups the value of labor per hour had a marked tendency to increase as the total labor cost per 100 lbs. F.C.M. increased. However, there was only a slight variation in the Calgary P.D. group, with no tendency for the value of labor to increase as the labor cost of 100 lbs. F.C.M. increased.

Selby, Burrier and Brandt, (16), found that the family labor was always valued lower than hired labor. This seemed to be the tendency

in these areas, but the main cause was due to the variation of the farmer's estimate of the value of his own and his family's labor.

If the dairymen gave a high valuation to their cows it would be expected that they would give more care and attention to their cows than those dairymen who valued their cows considerably lower. However, the value per cow appears to have little if any relationship to the cost of labor. In the Calgary P.D. group the value per cow does increase as the cost of labor per 100 lbs. F.C.M. increases, but for the P.S. of that area, the value per cow was just the reverse, decreasing as the cost increased. The relationship of the value per cow to production has been previously shown, and it is likely that any relationship of cost of labor to value per cow would be through production.

In summarizing the causes of variation in the cost of labor per 100 lbs. F.C.M. it was apparent that value of labor per hour and number of hours required for 100 lbs. F.C.M. directly caused most of the variation, and these items were in turn affected by various other factors. The number of hours required for 100 lbs. F.C.M. was dependent on production per cow, size of herd, and efficiency of labor. Value per hour varied with the farmer's estimation of his own and his family's labor and the cost of hired labor. A variation in any of these factors affected the total labor cost of 100 lbs. F.C.M. indirectly, by causing a variation in the number of hours of labor required for 100 lbs. F.C.M., or in the value per hour, which in turn causes a variation in the cost of labor per 100 lbs. F.C.M.

Cost of Buildings

Building charge was the third largest single item of expense in the cost of milk production. In Tables 5 and 6 it was shown to constitute

from 4.57% to 9.66% of the total cost of producing 100 lbs. F.C.M. for the Calgary P.D. and the Edmonton P.S. respectively. Somewhat similar results were obtained by Munger (1).

Tables 23 and 24 were compiled to show cause of variation in the building costs as found in these two areas. For Edmonton P.S. the variation was from $ .01 to $ .37 per 100 lbs. F.C.M. produced, while it was much less for the Calgary P.S. group, being from $ .03 to $ .15. For Calgary P.D. it was from $ .05 to $ .22. It is generally admitted that value of buildings is the dominant factor causing a variation in the building charge for 100 lbs. F.C.M., and it follows, as shown by the tables, that as the building cost increased for 100 lbs. F.C.M., the average value of the buildings increased and the average value of the buildings per cow also increased. This indicates that the higher building investment and hence higher building charge was not offset by the increase of production accruing from the better buildings, for the cost of buildings for 100 lbs. F.C.M. increased as the value of the buildings increased. That is, the distribution of the high and low cost buildings was equally distributed between the high and low producing herds, which is best shown by the P.S. groups.

For all the groups, neither the valuation per cow nor the production per cow showed any marked tendency to increase as the value of the buildings or the building cost per 100 lbs. F.C.M. increased, or in other words, the producers who valued their cows higher did not provide more valuable buildings than did the producers who valued their cows lower.

Severence and Johnston (3) found the same result and stated that: "It was very seldom that cows in more expensive buildings produced a larger quantity or a better quality of milk in proportion to the extra expense".

TABLE 23 - RELATION OF VARIOUS ITEMS TO THE BUILDING COST PER 100 LBS. F.C.M.

EDMONTON - F.S. 37

Classes for Building Cost per 100 lbs. F.C.M.	Average Bldg. Cost per 100# F.C.M.	No. of Farms	Size of Herd	Value per Cow	Average Yield per Cow	Average Value Dairy Buildings per Farm	Average Value Dairy Buildings per 1 Cow	Labor Cost per 100 lbs. F.C.M.	Size of Farm
	$			$	lbs.F.C.M.	$	$	$	Acres
Under .09	.05	14	16	47	7486	595	38	.18	245
.09 - .13	.10	12	19	44	6942	1820	74	.15	295
Over .13	.32	11	34	55	7573	5466	171	.14	397
Average of the Group	.12	37	19	48	7386	1786	90	.17	276

TABLE 24 - RELATION OF VARIOUS ITEMS TO THE BUILDING COST PER 100 LBS. F.C.M.

CALGARY - P.S. 18
I.D. 9

Producer Shippers

Classes for Building Cost per 100 lbs. F.C.M.	Average Bldg. Cost per 100# F.C.M.	No. of Farms	Size of Herd	Value per Cow	Average Yield per Cow	Average Value Dairy Buildings per Farm	Average Value Dairy Buildings per Cow	Labor Cost per 100 lbs. F.C.M.	Size of Farm
	$			$	Lbs.F.C.M.	$	$	$	Acres
Under .08	.05	7	25	33	6868	876	35	.16	401
.08	.08	4	28	42	3508	1304	47	.14	171
Over .08	.10	7	29	38	6026	1750	60	.22	405
Average of the Group	.08	18	27	37	4828	1308	47	.14	350

Producer Distributers

Under .09	.06	4	19	30	6865	792	36	.23	45
.09 - .12	.11	5	15	35	6033	757	51	.10	39
Over .12	.19	2	11	25	4033	948	88	.14	65
Average of the Group	.11	9	16	30	6192	774	49	.20	67

The average value of buildings per cow was much greater for the Edmonton P.S. than for either of the Calgary groups. This explains the higher cost of buildings for 100 lbs. F.C.M. for the Edmonton P.S. as compared with the Calgary groups. The higher yield per cow of Edmonton P.S. was not sufficient to offset the high value of buildings per cow by that group.

The tables show that for Edmonton and Calgary P.S. as the building cost increased the size of the herd increased rather than decreased, or in other words, the producers with the larger herds provided relatively more expensive buildings per cow. For the Calgary P.D. as the building cost increased the size of the herd decreased and the higher building costs per 100 lbs. F.C.M. of this group were due to the larger investments in buildings per cow where the herds were smallest. The reason for the P.S. to provide relatively better buildings as the size of the herd increased was probably owing to the fact that those producers with the larger sized herds intended to remain in the dairy business longer than those producers with the smaller sized herds, and therefore would provide buildings of a more permanent and expensive nature. Most of the P.D. having the larger herds were near the city, owned very little land, and tended to invest smaller amounts in buildings than the P.D. with the smaller herds. The Calgary P.D. had much smaller farms than either of the P.S. groups, which probably indicates that they were of a less stabilized nature in their business as compared to the P.S.

There appeared to be no relation between building charge per 100 lbs. F.C.M. and the cost of labor, for as the value of buildings increased, there was no perceptible reduction in the cost of labor per 100 lbs. F.C.M.

From the foregoing discussion it is obvious that the value of buildings

per cow is the main cause of variation in the building charge per 100 lbs. F.C.M. The size of the herd appeared to have some significance, but neither the value per cow nor the production per cow bore any marked relation to building charges. There was no tendency, within the various groups, for the dairymen on large farms to provide more expensive buildings for their cows than the producers on smaller farms.

Annual Cow Charge

According to Tables 5 and 6 of the total cost of producing 100 lbs. F.C.M. the cow charge varied from 3.19% to 7.49% for the Calgary P.D. and Edmonton P.S. groups respectively. Munger (1) found it to be 4.8% of the total cost of producing 100 lbs. of milk.

The annual cow charge depends upon the value of the cow, the rate of depreciation and interest, and the quantity of milk produced. The same rates of depreciation and interest were charged ~~were charged~~ for all of the herds, hence these can be disregarded in the discussion of the factors causing a variation in the annual cow charge per 100 lbs. F.C.M.

TABLE 25 - RELATION OF THE VARIOUS ITEMS TO THE COW COST PER 100 LBS. F.C.M.

EDMONTON - 37 P.S.

Production Classes	Average Yield per cow	No.of Farms	Cow Cost per 100# F.C.M.	Annual Cow Cost per Cow	Average Value per cow
lbs.F.C.M.	lbs.F.C.M.		$	$	$
Under 6000	5466	5	.107	5.8	47.
6000 -8000	7023	22	.086	6.5	48.
Over 8000	8773	10	.086	7.9	63.
Average of the Group	7325	37	.093	7.4	49.

TABLE 26 - RELATION OF THE VARIOUS ITEMS TO THE COW COST PER 100 LBS. F.C.M.

CALGARY - P.S. 18, P.D. 9

Producer Shippers

Production Classes	Average Yield per Cow	No. of Farms	Cow Cost per 100# F.C.M.	Annual Cow Cost per Cow	Average Value per Cow
lbs. F.C.M.	lbs. F.C.M.		$	$	$
Under 4000	3825	3	.103	3.9	32
4000 -6000	5285	7	.079	4.2	33
6000 -8000	7270	5	.085	6.2	50
Over 8000	8975	3	.061	5.5	44
Average of the Group	6216	18	.080	5.0	39

Producer Distributors

Under 6000	5329	5	.063	3.3	27
6000 -8000	7320	3	.061	4.4	35
Over 8000	8720	1	.050	4.4	35
Average of the Group	6563	9	.060	3.9	31

In Tables 25 and 26 the value per cow and the cow charge per 100 lbs. F.C.M. are given for all the different production classes of the different groups. There was a very close relationship between value per cow and the annual cow cost per cow. The tables show a general trend for the annual cow charge per cow to go up as the production increases, but at the same time there was a general trend for the cow costs per 100 lbs. F.C.M. to go down as production increased. The increase in the annual cow charge for the more valuable cows was more than offset by the increase in production of these cows, which resulted in a lower cow charge per 100 lbs. F.C.M. Hence in this study the two main factors influencing the cow charge per 100 lbs. F.C.M. were the estimated value of the cows and their production.

Miscellaneous Cost

Other items beside feed, labor, building and annual cow charge, which go to make up the total cost of producing milk are all grouped under Miscellaneous Cost. It included such items as bull charge or breeding fees, equipment charge, cost of hauling milk, veterinary cost, feed grinding, and other incidental expenses.

The miscellaneous cost was a comparatively large item, making up from 15.98% to 22.94% of the total cost as shown in Tables 5 and 6. The cost of hauling milk was the largest single item, being about 75% of the total miscellaneous cost. For the P.D. group it was even higher, and explains the larger miscellaneous cost of this group. Variations of the hauling charge depend primarily on the distance of the farm from the market. There was some variation in the equipment charge, but it was too small to be of any significance. Bull charge was also comparatively small, and varied with the size of the herd. Some dairymen owning small herds, who paid for the use of their neighbors' bulls had a much lower bull charge than dairymen with a similar size of herd who owned a herd bull. Other incidental expenses such as feed grinding, veterinary fees, milk license, etc., were quite small and variations were probably due more to differences in management than any other factor.

The total miscellaneous costs tended to increase per cow as production increased, as shown in Tables 3 and 4, and also tended to increase per 100 lbs. F.C.M. as production increased - Tables 5 and 6. The two producers with the highest miscellaneous cost had a comparatively higher hauling charge and a lower yield per cow than the producer with the lowest miscellaneous cost who had a lower hauling charge and a much higher yield per cow than the other two producers. Hence the hauling charge and production per cow seemed to be the prominent factors affecting the variations in miscellaneous

cost.

Summary

Feed and labor make up from two-thirds to three-fourths of the total cost of producing milk, consequently the producer should give more consideration to the control and understanding of these two factors than any of the others. Any substantial lowering of the total cost will be through a reduction of the cost of either or both of these factors, and as was shown in the previous section, the amounts of feed and labor used per 100 lbs. F.C.M. can be reduced by increasing the yield per cow. Consequently the milk production has an effect on the cost of these two items. Building and cow cost are relatively small, and are often regarded as indirect costs of production. If a farmer already has his buildings and his cows, these charges are existant before he produces the milk, and they are less under his direct control than feed or labor. Miscellaneous cost is also usually regarded as an indirect cost, and is made up of innumerable small items which by themselves are of little consequence, but in the aggregate amount to a noteworthy sum. Perhaps all the costs can be summarized by stating that on the more permanently established dairy farms any lowering of the cost of milk production will probably come through a reduction in the feed or labor cost, but when the producer is able to adjust and change the other factors of production, a decrease in the total cost may come from an alteration in any of the main items of cost.

A GENERAL SUMMARY OF THE FACTORS INFLUENCING PRODUCTION AND THE COST OF PRODUCING MILK

Throughout the thesis an attempt has been made to show the relation of the various factors to the production of milk and to the cost of producing

milk. Production was found to have the greatest influence on cost, but it in turn depends upon many other factors whose effects on the cost were indirectly through their effect on the production. Chief of these were feed, labor, and the inherent capacity of cows to produce milk. The influence of feed was found to depend upon the kind and amount of feed fed. It was also shown that less labor was used to produce 100 lbs. F.C.M. as the production increased, but there appeared to be other factors such as the size of herd and the efficiency of labor, which also influenced the amount of labor used. It was indicated that increasing the inherent capacity of the cows to produce milk increased the production and lowered the feed costs per 100 lbs. F.C.M.

Later the individual cost items, feed, labor, building, cow, and miscellaneous costs were treated separately in an attempt to determine the causes for the variations in the costs of each, and to show their relation to the total cost of producing milk. Feed and labor were found to comprise approximately three-fourths of the total cost, feed alone being over 50% of the total. Building and cow charge were relatively small and made up only approximately 10% of the cost. The rest of the costs were included under miscellaneous charge.

The cost of producing milk was based primarily on the 100 lbs. F.C.M. basis. The production of milk per cow, which is the expression of their inherent ability to produce milk, had a significant influence on the cost per 100 lbs. F.C.M., and was one of the main causes for the variations in the feed costs per 100 lbs. F.C.M. However the proportion of high-priced concentrates fed to the lower-priced roughages also had a direct bearing on the cost of feed per 100 lbs. F.C.M. Under labor costs the yield per cow

did not cause any apparent variation, although indirectly it affected the hours of labor required to produce 100 lbs. F.C.M. Other factors influencing the labor cost were valuation of labor per hour and size of herd. The difference in the investment of buildings caused most of the variability in the building charge. Value per cow and production were responsible for the difference in the cow charge per 100 lbs. F.C.M. Miscellaneous cost was influenced mostly by the hauling charge, which comprised about 75% of the total, and varied mainly with the distance from the farm to the dairy.

INCOME FROM THE SALE OF MILK

Before giving the final conclusion, a statement will be made regarding the selling price of milk and its relationship to the net income received from milk in these two areas during the summer of 1933 to the summer of 1934. Tables 27 and 28 give the income per cow and income per 100 lbs. F.C.M., and also the net income[1] per cow and per 100 lbs. F.C.M. for the different groups and production classes.

For all the groups the gross income per cow increased as the production increased, i.e., the greater the production, the more milk there was to be sold. The largest income per cow was in the highest production classes of all three groups. For both P.S. groups the last classes were the only ones whose incomes were greater than the costs. All of the other classes gave a net loss. The P.D., due to the higher price received from the sale of milk, had a greater net income than either of the P.S. groups.

The variation in the amount of surplus milk explains most of the

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[1] The net income per cow and per 100 lbs. F.C.M. was calculated by subtracting the income per cow and per 100 lbs. F.C.M. from the total annual cost per cow and per 100 lbs. F.C.M.

TABLE 37 - NET INCOME PER COW AND PER 100 LBS. F.C.M. FROM THE SALE OF MILK

REGION - F.S. 37
F.D. 1

Producer Shippers

Production Classes	No. of Farms	No. of Cows	Average Production per Cow	Income per Cow	Annual Expense per Cow	Net Income per Cow	Selling Price per 100 lbs. F.C.M.	Cost of Production per 100 lbs. F.C.M.	Net Income per 100 lbs. F.C.M.
Lbs. F.C.M.			lbs. F.C.M.	$	$	$	$	$	$
Under 6000	5	39	5436	64.70	66.62	-1.92	1.18	1.24	-0.06
6000 -8000	22	421	7028	85.30	89.01	-3.71	1.21	1.26	-0.05
Over 8000	10	215	8773	114.90	109.32	5.58	1.30	1.25	0.05
Average of the Group	37	735	7325	90.90	101.35	-0.05	1.24	1.24	----

Producer Distributors

6855	1	25	6855	200.00	194.85	105.15	4.00	1.54	2.46
Average of the Group	1	25	6855	200.00	194.85	105.15	4.00	1.54	2.46

TABLE 38 - NET INCOME PER COW AND PER 100 LBS. F.C.M. FROM THE SALE OF MILK

CALGARY - P.S. 18
P.D. 9

Producer Shippers

Production Classes	No. of Farms	No. of Cows	Average Production per Cow	Income per Cow	Annual Expense per Cow	Net Income per Cow	Selling Price per 100 lbs. F.C.M.	Cost of Production per 100 lbs. F.C.M.	Net Income per 100 lbs. F.C.M.
lbs. F.C.M.			lbs. F.C.M.	$	$	$	$	$	$
Under 4000	5	80	3825	44.30	50.70	- 6.40	1.16	1.32	-0.16
4000 -6000	7	137	5285	63.40	82.87	-19.47	1.20	1.57	-[illegible].35
6000 -8000	5	153	7270	79.70	86.62	- 6.92	1.10	1.19	-0.09
Over 8000	5	74	8075	115.90	79.16	36.74	1.20	[illegible]	[illegible]
Average of the Group	18	494	6216	73.20	76.48	- 3.28	1.18	1.23	-[illegible]

Producer Distributors

Production Classes	No. of Farms	No. of Cows	Average Production per Cow	Income per Cow	Annual Expense per Cow	Net Income per Cow	Selling Price per 100 lbs. F.C.M.	Cost of Production per 100 lbs. F.C.M.	Net Income per 100 lbs. F.C.M.
Under 6000	5	67	[illegible]	[illegible]	101.[illegible]	121.[illegible]	[illegible]	1.[illegible]	1.[illegible]
6000 -8000	3	[illegible]	[illegible]	[illegible]	[illegible]	114.20	[illegible]	[illegible]	[illegible]
Over 8000	1	18	[illegible]	[illegible]	151.[illegible]	[illegible]	[illegible]	1.[illegible]	[illegible]
Average of the Group	9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].74	1.[illegible]	[illegible]

difference in the net selling price between the different production classes. The selling price increases as production increases for the Edmonton P.S. groups. The other groups do not show this feature in quite the regular manner as the Edmonton P.S. group. Nevertheless there is a tendency towards it, and in both Calgary and Edmonton P.S. the largest production class received more per 100 lbs. F.C.M. than any of the other classes. Two causes are suggested for this difference in the selling price; first, the better managerial ability of the producers of this class in keeping down their total production close to their quota as set by the dairies, and second, the price given in the tables is the average yearly price, and it is likely that those receiving a higher price produced more milk when prices were higher, thus receiving an average higher yearly price. The city sweet price of the P.S. was the same for all P.S. at the same time, but the quota of their total amount of milk being sold at this price varied considerably. The P.D. sold milk directly to the consumer and received the retail price, which was substantially higher than the city sweet price.

Since the net income varies from a minus to a plus, the larger producing herds would lose more per cow but less per 100 lbs. F.C.M. than the lower producing herd. However, if the income had been positive for all the herds, the larger producing herds could have received less net income per 100 lbs. F.C.M. but more per cow than the lower producing herd.

Those herds with the largest production gave the largest net income. This indicates that if the production was still further increased there would be a greater net return per 100 lbs. F.C.M. The production could be increased either by obtaining better cows with more inherent capacity to produce milk or by altering some of the methods of production used with the present cows. It is likely the first method would yield a larger return

than the second.

Coming back to the question stated at the beginning of this thesis, whether or not the producer had reached the point where it was not profitable to increase the production by applying more of the production factors, it appears from the above figures that this point has not been reached, and the production could be increased further with a greater net income per cow, i.e., assuming present prices remain the same. Also it should be pointed out that the above conclusion is in general terms and would vary for the individual producers and the individual cows.

CONCLUSIONS

This study was made to show the influence of the various factors on the production per cow, and the causes for the variations in the cost of producing 100 lbs. F.C.M. Such a study would also suggest the combination of factors that would lead to the greatest net return from the dairy enterprise.

Analysis of the records show the cost of producing 100 lbs. F.C.M. was approximately $1.24 for both the Edmonton and Calgary P.S. groups. For the P.D. it was higher, being $1.543 for the one Edmonton P.D. and $1.876 for the Calgary P.D. group. The cost of feed varied from $ .653 to $1.107, and labor $ .107 to $ .232 between the P.S. and P.D. groups of the two areas, Edmonton and Calgary. Since the prices of feed and labor fluctuated considerably between different areas and during different years, these figures varied somewhat from those of other studies. Nevertheless, from a standpoint of quantity, the results correspond very closely with the results of other investigators.

It has been also shown there was considerable variation in the different cost items within the different groups. These fluctuations can be attributed primarily to variations in the following four factors: inherent capacity of the cows, feed, labor, and management. From the data it is

evident that those producers having high production costs per 100 lbs. F.C.M. either did not feed the proper rations to their cows, use the labor efficiently, have cows of proper inherent ability, or manage their herds efficiently. Therefore it can be concluded that the cost of production in many herds in these two areas can be decreased by the proper adjustment of any of the four factors shown. This may be accomplished by:-

1. Increasing the inherent capacity of the cows to produce milk. This can be accomplished by obtaining more efficient cows or by using better herd bulls and raising better heifers. Either method will result in lower costs of milk production. Higher production through the use of more efficient cows not only gives lower milk production costs, but it also gives an increase in the volume of milk for sale. Thus, even though there was no reduction in the cost of producing milk, the higher producing cows would give larger profits by increasing the quantity of milk that could be sold.

2. Adjusting the rations of the cows so that the largest amount of milk is produced at the lowest cost per 100 lbs. F.C.M. This can be done by feeding a larger amount of roughages and the cheaper feeds in proportion to the higher-priced concentrates, and also by keeping the amount of T.D.N. fed down to the amount required by the cows. According to feeding standards, higher yields are obtained where the nutritive ratio is low (1:7). The analysis however, indicates that in these areas with existing feed prices heavy concentrate feeding would not result in a financial saving to the producer; since the cost of concentrates are relatively high in comparison to other feed costs.

3. More efficient use of labor. The amount of labor used per 100 lbs. F.C.M. can be reduced by increasing the size of the herd, increasing the production

of milk or increasing the efficiency of the labor. The extent to which the herd can be increased and still give lower labor requirements depends upon the size of the farm and the equipment available. Production can be increased almost indefinitely, resulting in a lowering of the amount of labor required. Using better labor and more equipment will increase the efficiency of the labor. However, each farm presents a different problem in the use of labor, and it is impossible to give recommendations that would apply to each farm.

4. More efficient management. Good management includes the proper combination and coordination of all of the factors of milk production. The analysis has shown that the dairy business is made up of many complex inter-related factors, and the intensity of association of any one of these factors to the cost of producing milk is altered by the influence of other factors. Ordinarily, a high yield per cow is associated with a larger income per cow than a low yield. This however may not always be true, and depends upon the relation of many other factors such as the relation of the prices of the production items to the selling price of milk. The producers are not interested in the physical output per cow except where it directly increases their income. Hence the dairymen receiving the highest incomes are not necessarily those receiving the highest profits per cow. The most successful dairymen are those producers who have the managerial ability to combine all the factors of production in such a way that they will receive the largest net income from their cows.

BIBLIOGRAPHY

1. MUNGER, H.B.: The Cost of Producing Milk. Iowa State Bul. 197.

2. HARE, H.R.: Dairy Farm Survey. British Columbia Bul. 91

3. SEVERANCE, GEORGE AND JOHNSON, ERNEST R.: The Cost of Producing Milk, and Dairy Farm Organization in Western Washington. Washington State Bul. 173.

4. ADAMS, R.L.: The Cost of Producing Market Milk and Butterfat in 246 California Dairies. California State Bul. 372.

5. ROSS, H.A., HALL, H.F., RHODE, C.S.: The Feed Cost of Milk and Fat Production as Related to Yields. Illinois ~~State~~ Exp. Sta. Bul. 244.

6. MISNER, E.G.: An Economic Study of Dairying on 163 Farms in Herkimer County, New York. Cornell University Bul. 432.

7. MISNER, E.G.: Economic Studies of Dairy Farming in New York - VIII. Cornell University Bul. 462.

8. EZEKIEL, M.J.B., MCNALL, P.E., MORRISON, F.B.: Practices Responsible for Variations in Physical Requirements and Economic Costs of Milk Production on Wisconsin Dairy Farms. Wisconsin University Bul. 79.

9. MORISON, F.L.: Dairy and Other Livestock Production Costs in Medina County, Ohio. Ohio Ag. Experiment Station Bul. 424.

10. NEETHLING, J.C.: Economic Studies of Dairy Farming in New York - IX. Cornell University Bul. 483.

11. POND, GEORGE A., EZEKIEL, MORDECAI: Factors Affecting the Physical and Economic Cost of Butterfat Production in Pine County, Minnesota. Univ. of Minnesota Bul. 270.

12. CATHERWOOD, M.P.: A Statistical Study of Milk Production for the New York Market. Cornell Univ. Bul. 518.

13. WALLER, ALLEN G., RAUCHENSTEIN, EMIL: Farm Profits and Factors Influencing Farm Profits on 176 Dairy Farms in Hunterdon County. N.J. Ag. Experim. Station Bul. 534.

14. DOW, GEO. F.: Costs and Returns in Producing Milk, Raising Heifers, and Keeping Herd Bulls in Maine. Maine Ag. Experiment Stat., Orono, Bul. 361.

15. VENSTROM, CRUZ, HEADLEY, F.B.: Factors Affecting the Cost of Dairying in Western Nevada. Univ. of Nevada Bul. 128.

16. SELBY,H.E.; BURRIER, A.S.; BRANDT, P.M.: Cost and Efficiency in Dairy Farming in Oregon. Ag. Experiment Stat. Oregon, Bul. 318.

17. STEPHENS, H.P.: Economic Studies of Dairy Farming in New York - XI. Cornell Univ. Ag. Bul. 562.

18. GOWEN, JOHN W.: The Correlation Between the Butterfat Percentage of one Lactation and Succeeding Lactations in Jersey Cattle. Maine Ag. Experiment Stat., Orono, Bul. 291.

19. MAYNARD, L.A.; MCCAY, C.M.; WILLIAMS, H.H.: MADSEN, L.L.: 11. Further Studies of the Influence of Different Levels of Fat Intake upon Milk Secretion. Cornell Univ. Ag. Bul. 593.

20. MAYNARD, L.A.: MCCAY, C.M.: The Influence of Different Levels of Fat Intake upon Milk Secretion. Cornell Univ. Ag. Bul. 543.

21. HARRISON, E.S.: SAVAGE, E.S.: The Effect of Different Planes of Protein Intake upon Milk Production. Cornell Univ. Ag. Bul. 540.

22. BATEMAN, GEORGE Q.: Production Study of 160 Dairy Herds, Wellsville, Utah, 1929. Utah Ag. Col. Bul. 229.

23. FOWLER, H.C.: Seasonal Variation in Milk Production Under the Basic Rating Plan. Univ. of Vermont State Ag. Col. Bul. 353.

24. NEVENS, W.B.: Feeding and Management of the Dairy Herd. Univ.of Ill. Bul. 272.

25. RABILD, HELMER: H.P. DAVIS: BRAINERD, W.K.: The Feeding of Dairy Cows. U.S. Dept. of Ag. Bul. 743.

26. DICE, J.R.: Feeding and Management of Dairy Dattle. Ag. Col. North Dakata Bul. 51.

27. TURNER, C.W.: RAGSDALE, A.C.: BRODY, SAMUEL: The Relation Between Age, Weight and Fat Production in Dairy Cows. Univ. of Missouri Ag. Bul. 221.

28. HEADLEY, F.B.: Effect of Season on Fat Test and Milk Production of Dairy Cows. Univ. of Nevada Ag. Bul. 131.

29. MCCANDLISH, A.C.: Influence of Age at the Time of Freshening on Production of Dairy Cows. Iowa State Ag. Bul. 73.

30. GOWEN, JOHN W.: Studies in Milk Secretion VIII. Influence of Age on Milk and Butterfat Yield in Holstein-Friesian Cattle. Maine Ag. Station, Orono, Bul. 293.

31. GOWEN, JOHN W.: The Variation of Milk Secretion with Age in Jersey Cattle. Univ. of Main Ag. Exper. Station, Orono, Bul. 286.

32. TURNER, C.W.: The Influence of Age at First Calving on Milk Secretion. Univ. of Missouri Col. Ag. Bul. 164.

33. WILLARD, H.S.: Grain vs. No Grain for Dairy Cows. Univ. of Wyoming Ag. Bul. 202.

34. HAMPSON, CHESTER C.: Dairy Ratios. State Col. of Washington Ag. Bul. 309.

35. MISNER, E.G.: Relation of the Composition of Rations on Some New York Dairy Farms to the Economics of Milk Production. Cornell Univ. Bul. 64.

36. WYLLIE, JAMES: Investigation Into Farming Costs of Production and Financial Results. Univ. of London, Bul. 19.

37. SELBY, H.E.: JONES, I.R.: Cost of Keeping Dairy Herd Sires and Suggestions on Their Selection and Management. Oregon State Ag. Col. Bul. 312.

38. JARDINE, J.T.: BEAL, W.H.: Report on The Agricultural Experiment Stations, 1934. Office of Experiment Stations, Washington,D.C.

39. GAINES, W.L.: The Energy Basis of Measuring Milk Yield in Dairy Cows. Univ. of Illinois Ag. Bul. 308.

40. GAINES, W.L.: DAVIDSON, F.A.: Relation Between Percentage Fat Content and Yield of Milk. Univ. of Illinois Ag. Bul. 245.

41. HODGSON, R.E.: GRUNDER, M.S.: KNOTT, J.C.: ELLINGTON, E.V. A Comparison of Rotational and Continuous Grazing of Pastures in Western Washington. State Col. of Wash. Ag. Bul. 294.

42. POND, G.A.: RANNEY, W.P.: Factors Causing Variations in Earnings Among Dairy Farmers in Southeastern Minnesota. Univ. of Minnesota, Ag. Bul. 314.

43. HENRY & MORRISON: Feeds and Feeding Abridged.

44. LARSON & PUTNEY: Dairy Cattle Feeding and Management.

45. CRAIG, G.H.: Study of Production of Fluid Milk on 68 Dairy Farms in Edmonton and Calgary Milk Sheds.

46. HOPKINS, JOHN A.: TEGLER, P.: Cost of Production in Agriculture.

47. WHITE, G.C.: JOHNSON, R.E.: Corn Silage Feeding Investigations. (Ninth Paper) Connecticut State Col. Bul. 198.